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FRAME/WORK: HUMAN ISSUES IN INFORMATION TECHNOLOGY IMPLEMENTATION

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This report has been reviewed and is approved for publication.

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This report presents the results of "FRAME/WORK, Human Issues in Information Technology". The FRAME/WORK research investigated the cultural and contextual issues involved in the implementation of information technologies that create new forms of connectivity: e-mail, CAD, Electronic Data Interchange, workflow tools, shared databases, document imaging, and video teleconferencing. Based on this investigation, a readiness assessment tool was developed to assist SPO commanders and MIS support personnel in the implementation of these technologies in their organizations. The study used anthropological methods to assess work group and SPO culture and contextual variables, and develop an ecological model of the implementation of new technology as a form of adaptation. The findings of the study concern specific issues, such as organizational turbulence and fragmentation, security issues, and organizational structure that facilitate or inhibit the implementation of new information technology.

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PREFACE

The Logistics Research Division of the Armstrong Laboratory (AL/HRG) is tasked with understanding the impact of technology on people and organizations as new information systems move from the laboratory to field implementation in System Program Offices (SPOs) and Air Logistics Centers (ALCs). In 1992, the Armstrong Laboratory created an initiative in Human Issues in Technology Implementation to understand these issues and develop tools and knowledge that would support SPOs and ALCs in their efforts to adopt new technology.

The research reported here was an anthropological study of the cultural and contextual factors that affect the receptivity of work groups in AFMC SPOs to new information technology. The FRAME/WORK project investigated these factors and developed a computer-based readiness assessment tool for their assessment in the SPO environment. The research was carried out by Wizdom Systems, Inc., in cooperation with Wayne State University, under contract # F41624-93-C-5016 from the Logistics Research Division of the Armstrong Laboratory. The principal investigator was Dr. Allen Batteau.

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Appendices

0. Executive Summary

This report presents the results of **FRAME/WORK: Human Issues in Information Technology Implementation**, a Phase II Small Business Innovation Research Project performed by Wizdom Systems, Inc., under contract # FA1624-93-C-5016 to the Logistics Research Division of the Armstrong Laboratory, United States Air Force, AL/HRGA. The purpose of the FRAME/WORK project was first to identify the human, organizational, and cultural factors that impeded or facilitated the implementation of information technology in Air Force Materiel Command program offices and Air Logistics Centers. Following this, the second purpose of the project was to develop a software tool that would assist SPO and ALC managers in addressing these issues.

The FRAME/WORK project took an inductive approach, conducting complete cultural assessments of nine SPO and ALC components. This inductive approach, guided by current research in human factors and sociotechnical systems, produced results tailored to the needs and issues of the Air Force Materiel Command. In contrast to other studies testing hypotheses through field research, the FRAME/WORK approach concentrated on the discovery of sociotechnical issues and patterns in the AFMC. From this discovery, an assessment tool for examining different organizations and a set of issue reports and recommendations for managing the issues were developed.

The intent of the FRAME/WORK project lay in *making social science work for management* -- taking the most advanced results and methods of the social sciences, applying them in an AFMC context, and developing the results into a tool that would be useful for AFMC managers.

In this report, we first present the theoretical issues underlying the adoption and implementation of new technologies in large, complex organizations. These issues derive from a substantial body of research into sociotechnology which is the integration of social systems (consisting of groups, roles, statuses, and networks) with technological systems (systems for managing, transporting, and transforming material, energy, or in the present case, information). We have taken an adaptive approach to the joint optimization of the social and the technological system, using insights and findings from studies of cultural and organizational ecology.

We next present our conceptual framework, consisting of a series of eleven hypotheses that guided our empirical investigation. Although our approach was inductive (pattern-finding, rather than hypothesis-testing), these initial guiding ideas provided a useful structure.

In section 4 we describe this inductive approach, detailing the methodology, research design, sample issues, scope of investigation, operational variables, field techniques, and coding and analysis. The interview protocol for the field study is contained in Appendix B. Attention is given to our methods for the iterative development of an assessment instrument from our findings at the field sites.

Section 5 is a summary of our field research and other development activities, including software development. Additional detail on software development is given in appendices C and D.

In section 6 we present our findings in the following terms: those that have broad, general application for AFMC; those that are primarily at the level of a System Program Office; and intermediate findings involving issues both internal and external to the SPOs. Additional detail on SPO observations and results is contained in Appendix E.

Two initiatives were taken to determine the feasibility of using the FRAME/WORK tool in USAF applications development and implementation. The first of these was a review of USAF and DoD policies and procedures for information technology development and implementation. The second was a specific examination of how FRAME/WORK could support the deployment of JIMIS, the Joint STARS Integrated Maintenance Information System at the depot level. The results of both of these initiatives are presented in section 7.

Wizdom Systems, Inc., has received numerous inquiries from private firms expressing interest in the capabilities of the FRAME/WORK tool. Currently, FRAME/WORK is being adapted to two new industries: healthcare informatics and the automotive industry. Further domain development of the tool is anticipated. Wizdom's commercialization plans for FRAME/WORK are described in section 8.

We identified several promising areas for further investigation and tool development in the course of this research. These include an improved understanding of the management (as contrasted to user) culture that bears on the use of information technology, and the integration of readiness assessment tools such as FRAME/WORK with network-based systems. Our conclusions and recommendations are described in section 9.

The FRAME/WORK project, and the Armstrong Laboratory Human Issues in Technology Implementation initiative that supported it, have created for the U S Air Force an important new perspective on adopting and using information systems. This perspective complements and improves upon other DoD and USAF initiatives, including the Continuous Acquisition and Lifecycle Support (CALS) program, the Paperless Acquisition Initiative (PAI), Corporate Information Management (CIM), the Base Level System Modernization (BLSM) project, and HRGA's new program in Computer-Aided Business Engineering (CABE). The integration of the tools, methods, and insights of FRAME/WORK into these programs and initiatives will result in a far more effective and cost-saving use of information technology by the U. S. Air Force.

1. Statement of the Problem

The FRAME/WORK project was a Phase II Small Business Innovation Research (SBIR) project undertaken by Wizdom Systems, Inc., in cooperation with Wayne State University. Its purpose was to develop an understanding of the effects of U.S. Air Force and Program Office culture and human issues on the implementation of advanced information technology, and make those findings accessible in a form that would be useful to AFMC management.

The Logistics Research Division of the Armstrong Laboratory (AL/HRG) is tasked with understanding the impact of technology on people and organizations as new information systems move from the laboratory to field implementation in System Program Offices (SPOs) and Air Logistics Centers (ALCs). In 1992, the Armstrong Laboratory created an initiative in Human Issues in Technology Implementation to understand these issues and develop tools and knowledge that would support SPOs and ALCs in their efforts to adopt new technology. The objectives of this initiative were to:

> Define the domain and identify critical human impacts;
>
> Provide assessment methods for measuring these impacts;
>
> Provide systematic means to determine automation impacts, predict cost/benefit and success/failure, guideline for implementation.

In recent years, the military has spent billions of dollars on information systems, yet still faces the challenges of reducing paperwork and achieving efficient communication among components. Information systems having superior technical qualities are often rejected or ignored by users. Some of the sources of resistance to new technology include the complexity and difficulty of the use of some systems, and the loss of control or usefulness of old skills as new systems are introduced.

This situation is not unique to the U.S. Air Force. In American industry, this is frequently referred to as the "productivity paradox", which is the paradoxical situation that despite hundreds of billions of dollars of investment in information technology, industry has not realized commensurate improvements in output per man-hour. Various explanations for the "productivity paradox" include the mis-alignment of technology and business methods (Strassman), the failure to focus on process (Hammer & Champy), and the lack of user readiness for the new technology (Adler).

One important dimension of the problem is that human and cultural factors (HCF) frequently impede the adoption of new technologies. Although this is frequently attributed to some innate "conservatism" or "resistance to change" that is supposedly part of human nature, we know that some individuals and groups can be highly innovative. In fact, it seems more plausible to attribute both innovativeness and resistance to change less to innate human nature, and more to both the cultural background and the

immediate context in which people find themselves. Some cultures are known to be highly innovative, while others are very resistant to change. (Figure 1) Likewise, some individuals, no matter how open to change they are normally, will become quite averse to risk in certain situations. In short, to the extent that we can model both culture and context in ways that are meaningful for technological innovation, we can create a tool that will assist the manager in overcoming the cultural and contextual resistance to change.

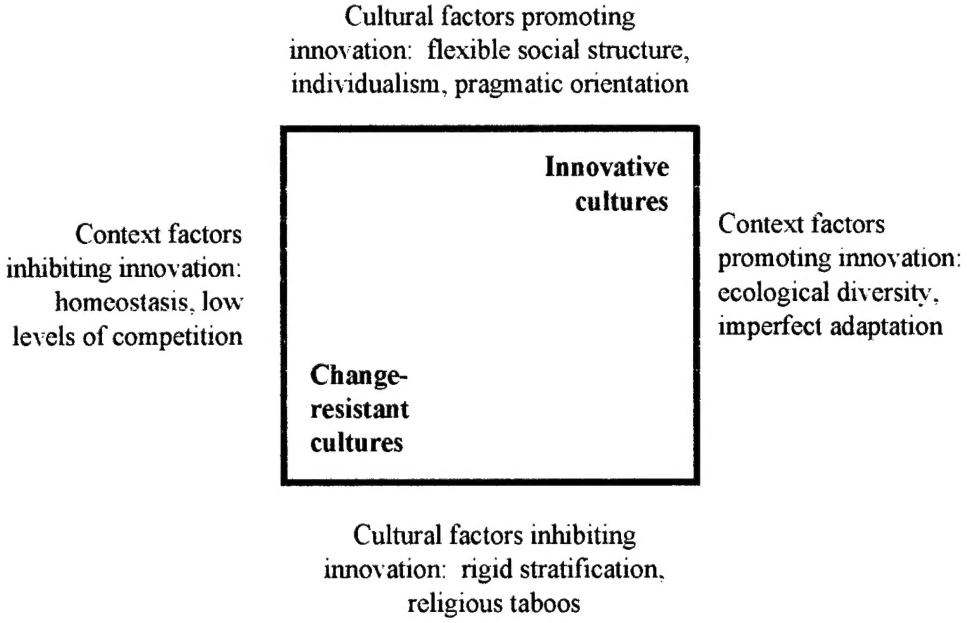


Figure 1 -- Cultural and environmental factors promoting innovation

By culture we understand a historically evolving tradition of practices and beliefs that are uniquely shared by an entire group. Because individual will belong to multiple groups, he or she will participate in multiple cultures and subcultures: one can speak of an American culture, an Air Force culture, an AFMC culture, the culture of a single SPO, and even the culture of work groups inside the SPO.

By context we understand the contingent situation of an organization or work group. Contextual features can include both the physical infrastructure and the budget and program environment and the SPOs relationship with other programs with which it competes for funds; contextual features can also include the world diplomatic situation: when the American armed forces are on full alert, the work routines inside AFMC change perceptibly.

In the next two sections we elaborate on our use of this concept. Our objective was to develop a method and a tool for giving the SPO or ALC manager leverage over the cultural and contextual issues that impeded or facilitated technological innovation in his or her organization. Our development of the tool rests on three premises:

- Monitoring and measuring are management functions. The idiom, "If you measure it, you will manage it," expresses important insights into the workings of management.

- A tool can support management, but it is no substitute for management. No tool can make a bad manager good; the right tools can make good managers better.

- An important class of management tools consists of those that collect, organize, and present information in an appropriate, high-level, focused manner. Examples of such tools include decision-support databases, spreadsheets, and forecasting models.

The tool we envisioned would be a *readiness assessment tool* with which a SPO or ALC manager could pinpoint the human issues that might impede the adoption of new systems within his or her organization. We have chosen the tool approach as an alternative to a printed report or other medium in the interests of the widest possible dissemination. We have chosen to embed within the tool an expert system that would capture what we learned from fieldwork in SPOs and ALCs.

We chose an empirical, inductive approach for building this tool. Presently there is no standard language or variables for user readiness or organizational barriers to systems implementation. As an alternative to asking the SPO directors and MIS managers about user readiness or their assessment tool requirements, we chose to ask the users about the issues that bore on their readiness to begin using new systems. This connection between human issues and technology implementation in the Air Force has been, in a systematic way, uniquely made by the Armstrong Laboratory program and the research, including FRAME/WORK, that it supported.

2. Theoretical Issues

The study we conducted in developing the FRAME/WORK tool was an empirical study guided by the conclusions of numerous other studies of the interaction of human issues and technological systems. Synthesizing these studies laid an important groundwork for our subsequent field investigation.

Our understanding of the relationship between technology and culture is drawn from two related theoretical traditions: socio-technical systems, and human and cultural ecology. Socio-technical systems theory (also referred to as STS) provides a broad conceptual framework for thinking about the ways in which technological and human systems influence one another. Human and cultural ecology theories offer an approach to culture that recognizes the role of material artifacts (e.g., technology) and the physical environment in shaping shared traditions of behavior and belief (i.e., culture). Both of these theoretical traditions are closely aligned with systems theory (von Bertallanfy 1956), and they may be related to one another in terms of general systems principles.

Socio-Technical Systems Theory

Socio-technical systems theory and methodology have been under development in the United States and Western Europe since the 1950s. Thousands of firms have contributed to the development of STS through implementation of STS principles in process re-design and new technology implementation programs (Taylor and Felton 1993).

The basic theory of STS holds that all work organizations are comprised of two interdependent subsystems: the technical subsystem and the social subsystem. The technical subsystem includes technology (i.e., tools, devices, methods, procedures for transforming inputs into outputs) and work process (i.e., the sequence of steps required for technological transformation). Classically, the social subsystem included the individual humans in the work organization and their social and organizational roles and relationships.

Empirical research in Great Britain during the 1940s recognized the distinctive, yet interdependent, status of these two subsystems (Trist 1981). The technical and social subsystems are distinctive in that each of them is shaped by different sets of natural laws. Technology operates in accordance with the laws of physical science, while humans behave in ways that are explained by the psychological and social sciences.

The interdependency of these two subsystems can be understood by thinking about what would happen if one or the other subsystem were to be removed from the work organization. Just as humans cannot

perform work effectively without tools and sequential methods of operation, technologies cannot function without humans and organizational structures to deploy, operate and maintain them. Without people, technology becomes inert matter eventually. Several implications follow from the observation that the two subsystems need each other (i.e., are interdependent). One implication is that they influence one another in a variety of ways. For example, technology can shape people's physical behavior (e.g., requiring them to sit at a work station and manipulate a keyboard). People in a work organization, on the other hand, can sabotage technology either overtly or covertly, rendering it useless.

Implications of Sociotechnology

The observation that technical and social subsystems are distinctive yet interdependent has significant implications for the management of technology in work organizations. One implication is that **an organization cannot simply change one subsystem (e.g., technology) and expect that subsystem to perform as it if were operating under laboratory conditions**. Once deployed in a work organization, a new technological system will be interdependent with the social subsystem in that organization, meaning that the social subsystem will have an influence on the functioning of the technology. This influence can either enhance or inhibit the technology's operation (Majchrzak 1992).

Another implication is that **significant change in one subsystem (i.e., technology) often will require changes in the other subsystem if the technology is to operate effectively**. The social subsystem in a work organization typically is adapted or adjusted to the old technology, and failure to alter the social system as the technology is changed can lead to suboptimal performance of the new technology (Adler 1989, 1990).

A third implication is that **changes in either the technical or social subsystems of a work organization must recognize and accommodate the principles of both physical and psychological/social sciences**. If a technology change program attempts to optimize the performance of the technology alone, forcing the social side to behave in accordance with physical principles and not considering the needs and requirements of the human/social side of the organization, then interference from the human/social side will cause the work organization as a whole to exhibit suboptimal performance.

This third observation yields the general principle of joint optimization, which states that the work organization should be designed or re-designed through mutual adjustment of both the technical and social subsystems (Trist 1981). Optimal performance in the work organization as a whole will be achieved when the needs and requirements of both the technical and social subsystems are considered and adjusted to fit each other, rather than attempting to optimize the performance of either the technical or social sides alone.

The principles of STS theory suggest that technology change must be planned carefully to include adjustments in the social side of the organization. New technology deployment provides an opportunity for re-design of the work organization, meaning a re-configuration of technical and social subsystems. This implies that the social subsystem should be well understood by those undertaking the reconfiguration; under most conditions it is not possible to re-design a social subsystem if the properties of the existing subsystem are not understood (the primary exception being a greenfield site, and even there the social backgrounds of participants often are taken into account (Stoffel and van Willigen 1986).

Socio-technical systems theory was developed in the 1940s and 1950s, and it bears the intellectual hallmarks of ideas from that era. Two limitations of STS theory as described above are a) it does not address the influence of the environment that surrounds the socio-technical system, and b) it does not include an explicit recognition of the role of ambient cultures. Human and cultural ecology embody a set of ideas that address these limitations, and add a number of additional concepts that are very useful in understanding the interaction of technology and people.

Human and Cultural Ecology

The science of ecology is concerned with the relationships between living organisms and their environments. Human and cultural ecology extend this concern to include human social systems -- human populations (such as work organizations) become the focus of investigation, both in terms of their relationships with the physical environment, and with other elements of the human environment (e.g., other cultures).

Cultural ecology is particularly concerned with the connection between culture-environment relations on the one hand, and the way in which these relations influence the interaction of elements within a sociocultural system on the other (Steward 1955, Ortner 1984). The internal patterning of a cultural system is viewed as the principal mechanism through which humans respond to environmental opportunities and constraints. From this perspective, culture is defined as a system of habitual behavioral practices and a related set of assumptions, beliefs, and knowledge that emerge through a social group's interaction with its environment.

So defined, culture represents an additional dimension of the social subsystem within an integrated socio-technical system, together with individual humans and their social relationships. Cultural patterns that emerge through time as a result of environmental interaction will influence the deployment of new technology in a work organization. Thus, cultural principles must be considered in planning for technology change.

Formal work organizations may be viewed as cultures (or subcultures) when they share a common goal and a common set of work tasks, interact regularly over long periods of time, and develop shared practices and beliefs pertaining to their work (Baba 1995). In this study for the Armstrong Laboratory, we conceptualized the entire U.S. Air Force (USAF) as a cultural entity or population, and also

viewed various AF subunits (e.g., SPOs or three letters) as subcultures if they displayed a lengthy historical tradition and shared patterns of behavior and belief.

The Concept of Environment

Environment is an ambiguous concept that may be defined in different ways from different points of view. Cultural ecologists have attempted to define the effective environment, including both objective (etic) and subjective (emic) conditions and characteristics of the cultural context that appear to have a bearing on group practices and beliefs (Manners and Kaplan 1972).

An important element of environmental analysis is the identification of specific ecological niches that are inhabited by different populations. Niche also is a difficult concept, since it can only be defined with reference to the behavior of its occupant (Hannan and Freeman 1989). Generally speaking, a niche consists of a specific set of environmental resources that are utilized and contributed by a specific population (Aldrich 1979). In organizational ecology, several types of variables (or dimensions) have been utilized to define niches, including: resource abundance and scarcity; environmental homogeneity and heterogeneity, stability and instability, and concentration and dispersion; degree of domain consensus; and degree of turbulence.

In classical cultural ecology, the environment generally has meant the geographical, biological, and cultural habitat surrounding a whole sociocultural system (e.g., a tribe or village). In organizational studies of ecology, on the other hand, the environment often has meant the external context of the entire organizational system (e.g., a corporation's market, competitive, or regulatory environment). Writers also have characterized the internal environment of a complex organization; i.e., the environment that exists inside a work organization, yet is external to the subunits within the organization (see Burgleman 1991, Baba 1995).

The cultural environment of work groups

The cultural environment of any given work group subculture has a number of components, including

- Other work group subcultures within the organization
- Dynamic interactions among these work groups which together constitute the overall culture of the organization
- Multiple cultural contexts external to the organization which have an influence on it (e.g., national, regional, or occupational cultures).

A comprehensive analysis of a work group's cultural environment includes an examination of culture-environment relationships within each of these categories.

Since our work for the Armstrong Laboratories focused on technology deployment in specific Air Force Materiel Command (AFMC) subunits, within the context of the acquisition and logistics processes, one logical approach to conceptualizing physical and cultural environments would be to use the internal patterning of the AF acquisition and logistics process itself as a framework for thinking about the effective environment. In the acquisitions and logistics process, new products pass through five broad phases, including:

1) concept origination
2) engineering design
3) engineering development and testing
4) manufacturing
5) maintenance

AFMC is attempting to integrate these phases through the Integrated Weapons System Management (IWSM) doctrine. Under IWSM all phases will be considered simultaneously as the process unfolds. In reality many formal work groups concentrate their efforts most intensely in one of these phases (e.g., engineering design, or logistics). For this reason, we conceptualized the environment of our focal units in terms of the acquisitions and logistics process and its inherent stage-process structure. The specific features of this environment at various stages comprise environmental variables that influence the development of work group subcultures. These sub-cultures, in turn, influence the deployment of new technologies within the environment. Environmental variables specific to the acquisition and logistics process are described in the next section of the report.

The Concept of Adaptation

A central concept in ecology is that of adaptation. The principal idea behind the ecologist's use of the term adaptation is that the population responds or adjusts to changing environmental conditions (including changes introduced by other sociocultural systems) in a way that enables the population to maintain or enhance those relations with the environment that are requisite to the population's continued existence and well-being. Adaptation is viewed as a process rather than an end-state, thus avoiding the tautology that is created when adaptation is defined as survival in a changing environment, and survival is then offered as proof of adaptation.

Human ecology (Hawley 1986) provides a useful addition to our thinking about adaptation by suggesting that communities of populations collectively adapt to environmental conditions, thus forming an interacting ecosystem, comprised of an interdependent network of populations and their environments. According to Hawley (1986), an ecosystem is an arrangement of mutual interdependencies among units in which the group of units operates as a single whole, thereby maintaining a viable relationship with the environment.

In our study, we viewed the distinctive subcultures of any given AFMC work group as an adaptive response to that group's environment, created by a pattern of interaction and interdependency among

communities or networks of work groups in which a focal group was embedded. Our data suggest that distinctive subcultures form as a response to interaction patterns among work groups in such ecosystems. For example, the cultural differences between engineers and logisticians are due, in part, to the different environments in which they work: the engineers work with ideas and concepts and images, whereas the maintainers work with metal and plastic and black boxes; the engineers rub elbows with program managers and budget officers and test pilots; the maintainers must work with depot commanders and shop technicians and pilots whose aircraft they have grounded. Although there are many engineers in the depots, and every System Program Office has a logistics function, in truth the SPO environment is a development environment, whereas the depot environment is a support and maintenance environment. Once formed, a distinctive subculture then plays a role in maintaining ecosystem interaction patterns over time. These principles are illustrated in later discussion of our findings.

The Concept of Change

Ecological change, defined as an irreversible and non-repeatable process that involves alteration of an entire ecological system, usually results from an interaction of external forces and internal conditions (Hawley 1986). Organizational ecologists, who examine adaptation by and within contemporary organizations have noted that organizations often display inertia in the face of environmental change (Hannan and Freeman 1989). Selection appears to favor reliable performance and stability, meaning that organizations develop routines or habitual practices that are highly resistant to change. An important debate in the literature of organizational ecology is between those who believe that organizations are basically inertial (meaning that new capabilities arise only when new types of organizations are born), and those who hold the contrary view that new organizational capabilities emerge gradually through conscious adaptation of existing organizations to environmental pressure (Hannan and Freeman 1989). (In contrast to cultural ecology, which considers primarily a group's adaptation to the natural environment, organizational ecology is more concerned with the social environment.)

From our standpoint, new information technology being deployed within AFMC within office and engineering environments presents not only an effort to change the socio-technical systems of AFMC work groups, but also reflects a significant environmental shift which challenges the existing structure and functioning of work groups and their ecosystems. New information technology and other change initiatives such as IWSM attempt to change the nature of work group boundaries and exchanges by bringing some groups into close connection with other groups that traditionally have been culturally distant (e.g., design and logistics, or the AF and external contractors). New technology deployment also adds significant turbulence to the environment.

In the FRAME/WORK project we found that in some ecosystems, work groups responded to this shift by vigorous efforts to maintain the status quo ante (i.e., resisting technological change), while others responded by participating actively in the process of new technology adoption and implementation (thereby transforming themselves). A key goal of our analysis was to gain a better understanding of

the factors and forces that played a role in shaping these two divergent types of responses to environmental change.

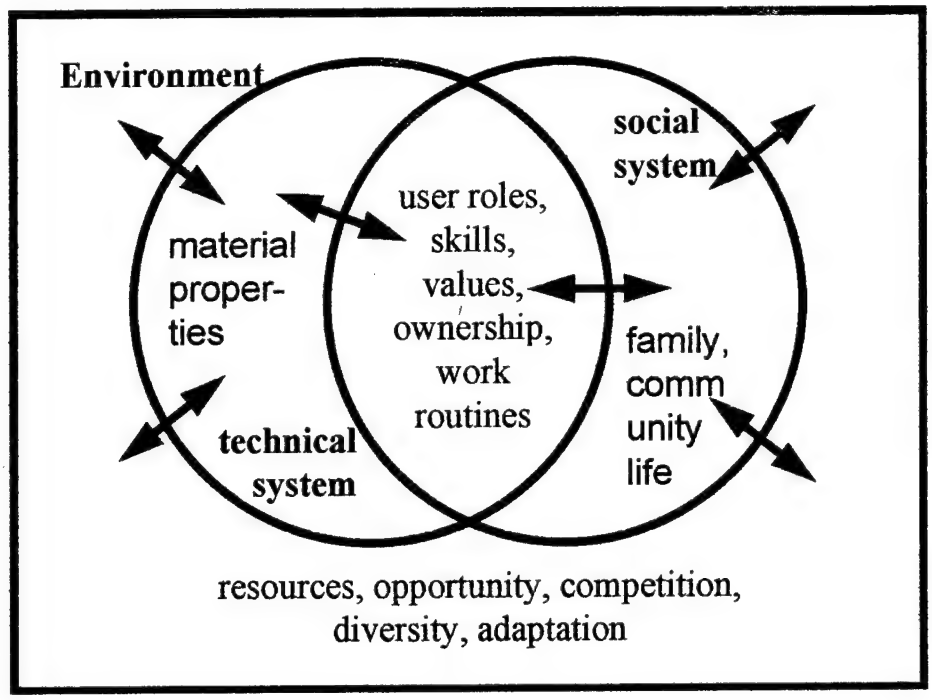


Figure 2 - Sociotechnology and Cultural Ecology

Integrating Socio-Technical System Theory with Human and Cultural Ecology

Bringing together STS and human/cultural ecology theory makes each of these approaches more robust. STS theory is enhanced by a) the addition of an open systems perspective (i.e., an understanding that socio-technical systems interact with their environments), and b) the enrichment of the social side through inclusion of its cultural dimension. Cultural ecology, on the other hand, gains from the STS focus on social roles, relationships and structure that was missing from classical approaches to cultural ecology (Ortner 1986). The process of further integrating these two theoretical traditions is an on-going challenge which is underway at Wayne State University's Laboratory for Socio-Technical Systems Integration. The laboratory recently received a major three-year grant (1995 - 1997) from the National Science Foundation to continue its efforts at conceptual integration.

At this stage, the conceptual advances that have been achieved from integration efforts include the following understandings:

1) Socio-technical systems do not exist in a vacuum, but are part of a larger environmental whole which includes both physical and cultural elements;

2) The social subsystem of a work organization has psychological, sociological, and cultural dimensions, the latter defined as an historically evolving tradition of behaviors and beliefs formed as a response to environmental interactions;

3) Technology change is influenced by the psychological, sociological, and cultural dimensions of a work organization;

4) Socio-technical systems (including their cultural dimension) exist simultaneously at several different (yet related) levels of analysis, including the level of the work group (e.g., a branch or division), the larger organization in which a work group is embedded (e.g., a SPO), and the macro-environmental level of the surrounding context (e.g., the United States, the Air Force, occupational culture of engineering);

5) Connections among socio-cultural entities (e.g., informal linkages between different work group subcultures, or personal orientations that connect different cultural contexts) may be one of the ways in which socio-technical systems at different levels of analysis are integrated. In this same vein, behavioral, cognitive, and intellectual boundaries between cultural entities inhibit potential linkages across units that could be facilitated by technological means (as will be illustrated repeatedly in the discussion of our findings).

3. Conceptual Framework

In developing the FRAME/WORK tool we took an inductive approach to understanding the interaction of culture and technology in AFMC; we were guided in this by a conceptual framework and a set of hypotheses describing possible relationships between work groups, their relationship to their environment, and their acceptance of new information technology. Rather than simply testing a set of hypotheses, our intent was to take ideas and results from our research and previous research, and make it useful to AFMC management.

The conceptual framework for our research begins from the assumption that work organizations are socio-technical systems (in the terms described in the previous section). This means that an understanding of the factors and forces that influence the deployment and implementation of new information technology must include an investigation of the psychological, sociological, and cultural properties of the work organization (i.e. the social subsystem), and the nature of interdependencies between these properties and the technical subsystem. An approach that examines only one of these dimensions (e.g., only the psychological characteristics of individuals) will fail to identify other significant factors (e.g., those emerging from the sociological context, including those related to the shared patterns of behavior and belief, or culture). We assume that the *AS-IS* social subsystems in various organizational units (including psychological, sociological, and cultural properties) may act as facilitators of technology change, or they may inhibit such change.

A second assumption that underpins our conceptual framework is the notion that the socio-technical system forms in part as a response to environmental opportunities and constraints. Thus, in seeking regularities across organizational subunits in responses to technology change (e.g., adoption versus rejection of new technology), we must examine pre-existing environmental properties and look for ways in which these properties are linked to regularities in socio-technical systems. If certain environmental properties are regularly associated with certain types of socio-technical systems (i.e., those that regularly resist or accept change), then we may be able to predict the location of socio-technical barriers and plan for their management or elimination.

Our exploratory Phase I research was aimed at identifying independent variables related to environments, and to properties of existing socio-technical systems (i.e., work groups), that might be regularly linked to our primary dependent variable (i.e., implementation or non-implementation of new information technologies). This early research identified several independent variables that held the potential to explain differences in work group responses to technology change. Systematic data gathering in Phase II confirmed or refuted the significance of these early variables, and brought other potentially significant variables to our attention. These variables all emerged out of the field study of eleven different AFMC components. The importance of this is in understanding user-level issues. All of these environmental and socio-technical variables (described below) may be understood within the

context of our theoretical framework. Later discussion of our research findings identifies those variables that were supported, and those that were refuted.

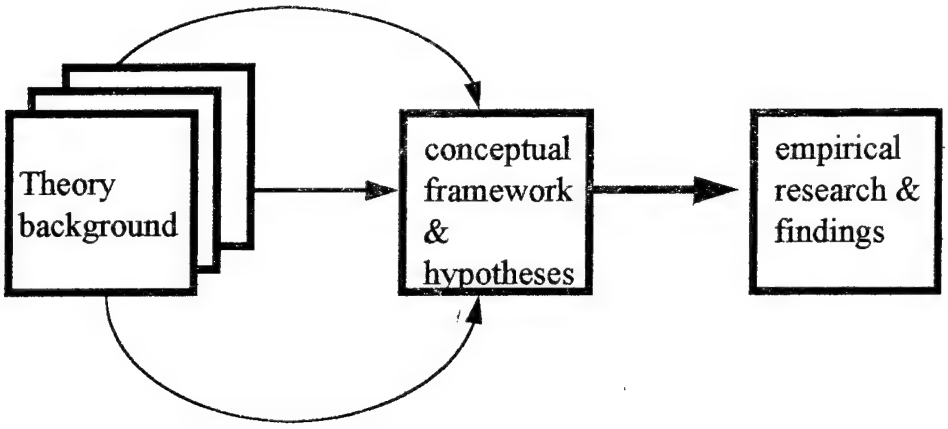


Figure 3 - Development of hypotheses and empirical findings

Independent Variables Related to the Environment

Stage in Acquisition/Logistics Process. Our conceptualization of the environment suggests that work groups may be located along a stage-process continuum associated with various phases of the acquisition/logistics process. Depending upon the phase in which a group concentrates its efforts, the physical and cultural environment of the group will differ (Baba 1995). For example, groups that concentrate on engineering design will have intensive interactions with the design departments of contractor organizations, while those that concentrate on logistics will have more contact with flying aircraft and their crew.

Hypothesis #1: differences in these environments may stimulate or impede work group interest in new information technology (e.g., since AF design engineers rely on designers from contractor organizations to be knowledgeable regarding computer-aided design technology, the AF engineers might not be highly motivated to take an interest in such technology themselves).

Volume of Paperwork. Many of the new information technologies under investigation are designed to manage the volume and flow of paperwork. We reasoned therefore that work groups with a high overall volume of paper under their control might be interested in new information technologies with support paper management. This hypothesis follows from

Rogers' (1982; Tornatzky and Fleischer 1990) work which shows that innovations which are compatible with a group's needs will be adopted more readily.

Hypothesis #2: Since the volume of paper tends to grow over the life of an aircraft program, we hypothesized that groups farther along in the acquisition/logistics process (e.g., logistics groups) might be more highly motivated to adopt new technology.

Resource Abundance or Scarcity. Also following from Rogers' (1982) observations, we reasoned that new information technology often is costly and also represents a risk (since the payoffs are unknown at the point of adoption). Therefore, groups with available slack resources should be more likely to invest in technologies with uncertain outcomes.

Hypothesis #3: Larger programs with reasonably stable funding (e.g., the B2 program) should be candidates for new technology adoption.

Turbulence. Turbulence means that the environment is changing in ways that are not controlled by the work group, and that changes originating in distant locations disrupt operations at the local level, often without warning (Emery and Trist 19). While new information technology may enable the work group to become aware of disturbances before they disrupt operations, the very fact of turbulence sets up conditions that make new technology integration very difficult (i.e., because the experts and champions who are needed to get it up and running cannot be counted on to remain in residence over the duration of the implementation period).

Hypothesis #4: Higher degrees of turbulence may be associated with fewer successful examples of technology integration over time.

Supplier Environment. An important element in any organization's environment is the nature of other organizations that surround it, and with which it interacts. Relations between a focal organization and other organizations in its environment are one of the significant factors influencing the behavior of the focal organization (Alrich 1979). If distrust exists between one organization and another, then there could be barriers to the flow of information between them (Baba 1995). Because information is a resource that can be used either as a means to gain advantage for an organization, or to harm an organization, access to vital information often is protected from distrusted outsiders. Trust includes confidence in the other's competence in his intentions.

Hypothesis #5: Relations of trust or distrust between the Air Force and its suppliers influence the ease with which electronic connections are established between them, and the extent to which these connections are used.

Air Force Culture. As our fieldwork progressed our understanding of Air Force and AFMC culture increased, leading to an understanding of additional critical variables. The cultural

characteristics of the US Air Force represent an important dimension of the cultural environment of the SPOs and ALCs that are adopting information technology. Characteristics of this cultural environment could influence technology adoption and use, or rejection, in a variety of ways. For example, the Air Force appears to view technology as *the* solution to many of its problems (as evidenced by the heavy reliance on advanced weapon systems in recent hostile engagements). When managers believe that technology is a "silver bullet" that can be "thrown at" difficult problems with the expectation of automatic or immediate results, there is a danger of certain misconceptions which can place technology deployment at risk (see Baba et al 1995). One of these misconceptions is the notion that you can "plug it in and forget it", without the need for careful adjustments in skills, process, and structure that often are required to get the maximum benefit out of new technology (Adler 1989). Another element of Air Force culture that influences technology adoption is the contrast between patterns of mobility in the military and civilian services. Military executives change positions more rapidly than civilians, and this movement may represent a disruptive force with respect to new technology deployment efforts, particularly if military executives are the primary drivers of change.

Hypothesis #6: Units closely associated with these mission-critical activities (e.g., engineers who develop fighter engines) may not be interested in new information technology unless it directly benefits the primary mission (otherwise, it may be viewed as uninteresting or unimportant).

Independent Variables Related to Properties of Socio-Technical Systems

In addition to these variables derived from cultural ecology, we have a set of variables and hypotheses derived from the sociotechnical systems theory. Again, the hypotheses presented here were less hypotheses that we were testing than they were ideas that guided our empirical investigation:

Pre-Existing Technology Use. The existing technology utilized by a work group is an integral component of the group's *AS-IS* socio-technical system. This means that the group probably has in places social subsystem elements that enable it to utilize the technology that is already present.

Considered as hardware and software, legacy technology is a technical variable. Considered in terms of attitudes and user roles, legacy systems are an important sociotechnical variable. Attitudes are particularly revealing, inasmuch as they reflect both enduring values (culture) and current use patterns (context).

Hypothesis #7: The more advanced the existing technology, the more likely it is that other advanced technologies will be compatible with existing social system elements, and thus more likely to be integrated successfully.

Hypothesis #8: Positive user attitudes toward existing computer systems will support the implementation of new systems.

Organizational Structure, fragmentation, size, and type. Work groups (or other organizations) that display many internal boundaries (e.g., a functional division of labor, with occupational "chimneys" that communicate vertically but not horizontally) will be incompatible with information technologies that seek to link groups horizontally. Organizational boundaries create trust problems between groups, and information technology that links a group with distrusted others may be rejected as too risky, or irrelevant (Baba 1994). Other elements of organizational structure that may influence receptivity to information technology include if the work group is co-located, and if they travel frequently (Kiesler and Sproull 1991).

Hypothesis #9: Basket SPOs would not be the most likely candidates for new technology adoption, since their resources would be distributed across many different programs, not allowing the concentration required for major technology purchases (see also Aldrich 1979). Large, single program SPOs, on the other hand, would be more likely to have a concentration of resources needed to fund new technology.

Age of Organization. Stinchcombe (1990) discovered that organizations bear birth marks from the era in which their structural form was invented. Likewise, organizations adopt the technology that is current during their period of formation, simultaneously developing structures and cultures that are compatible with these technologies.

Hypothesis #10: Programs born more recently are born more likely with advanced information technologies already in place, and also would display structures and cultures that were compatible with these technologies.

Occupational Prestige. Part of the informal organization of all work organizations is a status and prestige hierarchy among occupations, and units that house these occupations (Briody et al 1995). The status hierarchies found in organizations are imported largely from the surrounding society (i.e., the environment), but once imported they become an integral part of the socio-technical system. Prestige can influence the adoption of new technologies in a variety of ways (Roberts 1994). Groups generally will adopt technologies that enable them to enhance or maintain their prestige, while rejecting technologies that challenge their privileged position. Whether the technology is adopted or rejected depends on the group's view of its impact on their status.

Hypothesis #11: Since relatively lower status groups (e.g., logistics vs engineering) have the most to gain, we hypothesized that they would be most likely to experiment with new

technologies that could enhance their capabilities and perhaps their stature in the organization.

Discipline or Function. The discipline or function that is dominant in a work group can influence the technology-related behavior of individuals in the group. Discipline-based professions and occupations have subcultural characteristics rooted in the historical development of the discipline, and in the type of work performed by members of the discipline (e.g., physicians, salespeople, engineers; van Maanen and Barley 1984, Rice 1993). These subcultural characteristics also are imported from the surrounding society. Each discipline has a distinctive relationship with technology -- the role and importance of technology, the type of technology that is most familiar, and the way technology is used all may be subcultural characteristics (i.e., are shaped by shared, historically-grounded patterns of behavior and belief). Some disciplines may be more comfortable with certain types of technology, but also may have stereotypical views of other technologies that serve as barriers to technology adoption (e.g., engineers often believe they are masters of technology, but older engineers may view keyboards as symbolic of the clerical function).

Hypothesis #12: Disciplines or occupations that are most familiar with CALS-like information technologies, and which view the use of such technologies as an appropriate aspect of occupational behavior, could encourage greater receptivity to the adoption of such technologies among their members.

Implementation Process. Research has shown that organizations with a deliberate implementation process (typically including acquisition planning, user involvement, leadership roles, training, deployment schedules, and user support) have far greater success at implementing new systems than those that simply load software and expect it to be used (Tornatzky and Fleischer 1990). Our review of DoD literature found little guidance on implementation processes, suggesting that (particularly given SPO autonomy) there would be great variation among SPOs.

Hypothesis #13: Organizations that create and execute an implementation plan, particularly when the plan includes user roles, training, and support, will have greater success than those organizations that do not.

In sum, our conceptual architecture embraced thirteen environmental and sociotechnical systems variables. These were operationalized through an interview protocol, and their association with levels of information technology usage, attitudes and policies, were examined in the different field sites. Although we derived a hypothesis for each of these variables, the hypothesis had more the status of a "first cut" at explaining how the variable operated. This permitted us to see the effects of the variables in some new and unexpected ways.

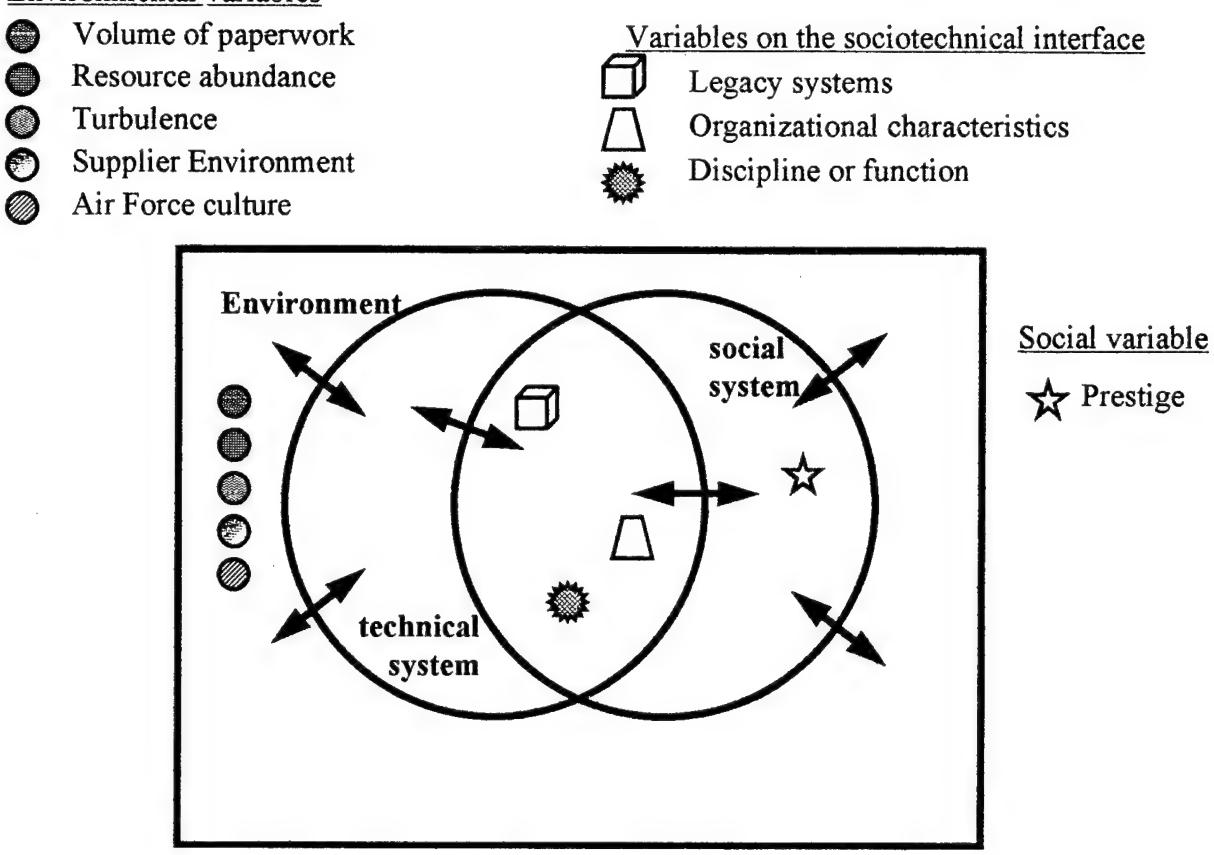


Figure 4 - Conceptual Map

4. Approach

The approach chosen for developing the FRAME/WORK tool was an integration of cultural anthropology, management theory, and engineering development. Integrating these standalone disciplines, for purposes of both conducting the study and developing the readiness assessment tool, required some adjustment of their conceptual boundaries and a willingness to synthesize previously unrelated fields.

4.1 Methodology

Our core focus was on the human and cultural factors in implementation. Given this, we were immediately faced with the difficulty that there is no standardization for these factors or issues in the literature, industry, or the military. Unlike performance issues in information systems, where there are standard measurements and benchmarks (mips, baud rates, gigabytes of storage), there is no canonical statement of the barriers or readiness factors. Where there is consensus, such as on the need for champions or process alignment, there are no standardized measurements.

To understand these variables and develop measurements for the AFMC context, we chose a field ethnographic approach, examining cultural patterns inside 11 SPOs and ALC sites. In ethnographic research, the observer is searching for recurrent patterns of behavior and belief. The ethnographer -- usually a solo practitioner -- approaches the site naively, and immerses himself or herself in the setting. In contrast to a laboratory or survey approach, the ethnographer is observing behavior in a naturalistic setting; behaviors or beliefs that might be suppressed or hidden in laboratory or survey studies, are revealed in the naturalistic ethnographic setting. Some of the observations that this yielded are described below.

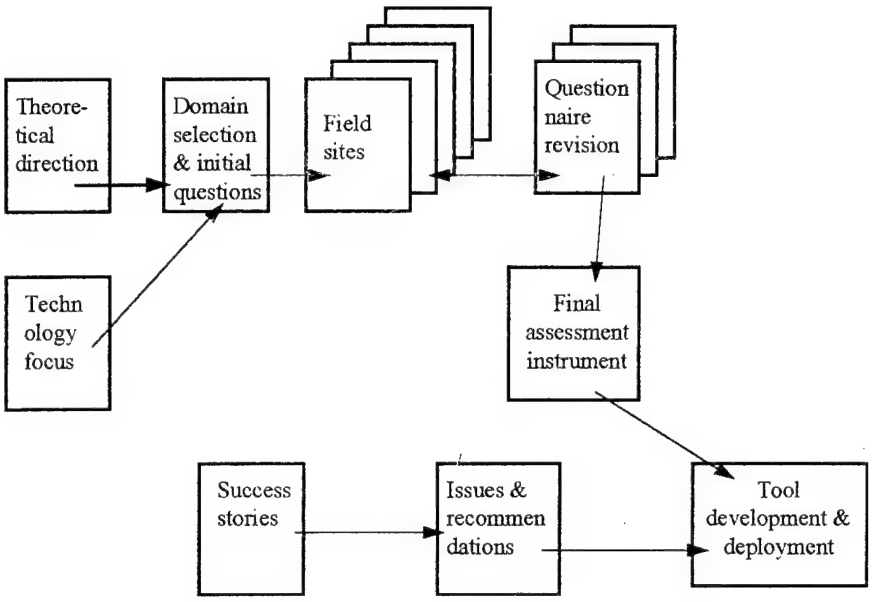


Figure 5 -- Research and Tool Development Approach

The goal in ethnographic research is the discovery and validation of these patterns of belief and behavior. Given the nature of the sample and the broad focus of the inquiry, the ethnographer is less concerned with statistical reliability or confidence intervals, and more concerned with meaningful patterns. There are advantages and disadvantages to this approach: the disadvantages are the dangers of insufficient depth in observation, yielding superficial patterns; the advantages are that when done well, with sufficient depth and discipline, the ethnographic report that can communicate the multidimensionality of a given situation.

> *As an example of type of findings that ethnography yields, one might consider the status differences between functions in AFMC. Specifically, the logistics function represents what Greenberg would characterize as a "marked" category (Greenberg 1966). Ahead of every other function including program control ("bean counters"), the "loggies" are characterized by several colorful terms, such as "wrench turners". Efforts to counteract this (in the spirit of IWSM) have invented awkward terms such as "maintainers" for the "loggies". One makes several observations: (a) the "loggies" being at the end of the developmental food chain, have to correct all the problems created by other functions in order to make the aircraft fly; (b) they work in what are sometimes physically disagreeable conditions; and (c) the characterization "wrench turners" implies that they work only with their hands, not their heads (even though this is quite false). In other words, we accumulated a number of qualitative observations that form a consistent pattern of the logisticians as having a subordinate status.*

We chose an ethnographic field approach because no other approach can anticipate all of the situational contingencies of a given human setting -- contingencies that may be critical yet overlooked by more structured methods. For example, a serendipitous finding of the study was the importance of diversity in the computer support group. As elaborated in section 6, we concluded that it was important for the demographics of the support group to reflect those of the group supported. Particularly if the user group is heavily minority, female, or less educated, a support group that is exclusively white male computer specialists will have limited effectiveness. This is a finding that initially was nowhere on our schedule; we were not looking for this, yet it became apparent on the basis of immersion in the SPOs.

4.2 Research Design

Having chosen the ethnographic approach, an immediate problem that presented itself was its application to AFMC. To the best of our knowledge we are the first ethnographers to conduct a study of the Air Force Materiel Command. The traditional ethnographic setting has been the village, a small group of 100 to 500 persons living and working in reasonable proximity. AFMC by contrast is several orders of magnitude larger in scope and scale: AFMC has more than 110,000 employees, consisting of 35 thousand military and 75 thousand civilian; Wright-Patternson AFB, the home of AFMC (as well as numerous other USAF components) has 28 thousand military and civilian workers spread out over 13 square miles.

Unit of Study and Sample Definition

We decided that our basic unit of study would by the Systems Program Office, or SPO. A finding late in the study was that there was less than universal understanding in the Air Force regarding what is a SPO. For practical purposes we defined a SPO as a two-letter directorate within the Aeronautical Systems Center (ASC), the Electronic Systems Center (ESC), or the Missile Systems Center (MSC). However, ongoing reorganization frequently undercut this decision: the Joint STARS program changed its office symbol during the course of the study; the FACTS program (Fasteners, Actuators, Connectors, and Tools) (ASC/SMGH) was sometimes considered a separate SPO (rather than program) within the Subsystems SPO (ASC/SM). The C-17 SATAF at Kelly AFB was frequently referred to as "SPO South". The IWSM (Integrated Weapons System Management) philosophy, which eliminated the barriers between SPOs and ALCs regarding system lifecycle responsibilities, was initiated during the study. In some respects our efforts to study acquisition and logistics cultures were like an effort to check the tire presssure on a fast-moving truck.

Unique Sample Issues

This discussion of our sample definition is significant, because it builds on and refines two critical issues. The first is the ongoing turbulence within the Air force environment. With the victory in the Cold War and the downsizing of our military forces, the Air Force and other services are experiencing in the 1990s the turbulence that the corporate world experienced in the 1980s. This turbulence has a negative impact on systems implementation, as described below. The difficult paradox of many Air Force components this day is they are required to do more with less, even as the fast-moving dynamics of "more" and "less" interfere with the adoption of tools--information systems--that might make it possible.

Second, there is within AFMC a strong tradition of SPO autonomy. A strong case could be made that the more significant culture-bearing groups are the functional two-letter directorates (ASC/EN, engineering; ASC/PK, contracting; ASC/FM, program control, etc.); indeed, we heard of and observed fascinating cultural traits in many of these organizations. However, it is within the SPO that schedules, budgets, supplier capabilities, technologies, personalities, and customer requirements must all be integrated; the introduction of new information systems is usually a dependent variable in this equation. The autonomy granted to the SPOs is a recognition of the difficulty of this task. It is within the SPO where the different human forces we observed bearing on innovation were played out.

Scope of investigation

Our study focussed on the implementation of seven specific types of systems within the SPOS. After our preliminary field inquiries, we concluded that CALS was not a viable domain of study because of the low level of implementation. Further, in terms of human (as contrasted to engineering or management) issues, there seemed to be few issues that were unique to CALS; most seemed to bear on a variety of information systems. However, "information systems" is a broad category that could potentially include typewriters, mainframe computers, fax machines, 5-ply carbonless paper forms, and everything in between. We established three basic criteria to determine which information systems we would focus on. The information systems had to be systems that:

1. Were visible to the user; this focussed us on applications, rather than networks or operating systems;

2. Created new forms of connectivity and communication among users; and

3. Required the alteration of work routines and patterns for their effective implementation.

Criterion #1 excluded Local Area Networks (LANs) and mainframes, although applications running on these might be included (we found, in both user and support groups, no clear-cut distinctions among applications, communications, and hardware platforms; "the system" or "the computer" usually referred to some integration of all of these). Criterion #2 excluded standalone applications such as word processors and spreadsheets. Criterion #3 excluded telephones and fax machines; although one could suggest that these create new forms of connectivity and communication (especially IVR, or Interactive Voice Response systems), there is little evidence that work routines, particularly in line organizations, have been modified to leverage their potential.

Applying these tests, we established seven classes of systems whose implementation we would study. These are:

1. **E-mail**; although a familiar technology in most parts of AFMC, we found that in some organizations this was still cutting edge, and causing considerable turmoil in its implementation. Examples of e-mail systems include PROFS, CC:mail, and All-in-One.

2. **Shared Database Systems** are the largest class of systems used in the SPOs and ALCs. They are repositories of information that may be accessed by different users, often using different types of terminals located in different places, either on a client-server or mainframe architecture. Examples of shared databases include: C-PAS Mapper; SPO-MIS; SPLIC.

3. **CAD/CAM tools**. Computer-Aided Design (CAD) tools automate many of the functions of engineering design, including drafting, analysis, and version maintenance. Computer-Aided Manufacturing (CAM) tools create machine instructions from engineering information. The integration of CAD and CAM, essential for integrated product and process development, is more frequently wished for than achieved.

4. **Electronic Data Interchange (EDI)** is the exchange of business information, including quotations, orders, and payments, between business partners across communication lines. EDI uses a large number of electronic forms or transaction sets, standardized by the ANSI X.12 or EDIFACT standards.

5. **Video Teleconferencing** applications provide remote meeting capability by providing (usually less than full-motion) video transmission over telephone lines. Video teleconference participants can see each others' faces and hear each others' voices; due to the data compression and transmission rates, motion is typically jerky. Use of satellite links creates propagation delays resulting in a not-quite synchronous dialogue.

6. **Document Imaging Systems** scan paper documents into an electronic file, typically in rasterized form with data compression capability. These systems have very large memory requirements.

7. **Workflow tools** automate many aspects of business processes. When a workflow tool such as Lotus Notes is configured with a specific process, it manages the process by routing documents, maintaining schedules, and storing documents, according to process instructions.

By restricting our investigation to a specific range of contexts -- development and support environments in AFMC, and a specific range of technologies, we have been able to focus on issues that will be meaningful to technology managers in those contexts.

4.3 Variables examined

In the field research, the seven technologies listed above were treated as dependent variables; that is, their presence (or absence), and level of usage, were what we sought to explain. Based on our ecological and sociotechnical systems models, we established 12 variables that were examined at each site. These variables, with supporting detail, are:

A. Type of Organization, including:

1. Organizational mission: what kind of work is performed in the organization
2. Organizational design: formal organizational structure
3. Team structure: what kinds of teams are formed, and who is included on the teams
4. Age of organization: when the organization was started
5. Physical environment: the physical conditions of the building and work areas

B. Group size: how many people are part of each work group

C. Fragmentation, including:

1. Occupation and function of each individual interviewed: what their tasks include
2. Workprocess used to perform the various functions: flow of work in the organization
3. Tasksharing: whether specific tasks are shared or individualized
4. Collocation: whether people who work together sit together, other locations of

organizational members, and the amount of travel personnel routinely expect

5. Internal relations: social relations inside the office and outside it

D. Turbulence, including:

1. Organizational turbulence: changes being experienced by the organization, including organizational structure and mission changes, changes in the number of personnel, changes in management, task changes, and changes in location

2. Perceived risk of organizational turbulence: how much risk was associated with organizational changes taking place

E. Implementation Process, including:

1. Technological change process: how new office information and communication technology is implemented

2. History of technological change: past implementation attempts, successes and failures

3. Technology change plans: plans for new technology implementation

4. Champions and anti-champions: the presence and activity of people who champion new technology implementation and usage and those who actively resist it

5. Computer support: the size and diversity of the computer support group, as well as support activities

6. Training: amount of information and communication technology training taken by each individual, and the amount and availability of training offered by the organization

F. Technology Attitudes, including:

1. Personal attitudes: positive and negative attitudes toward information and communication technology expressed by each individual and group interviewed

2. Cultural attitudes: interviewees' perceptions of other people's attitudes about technology, the perception of the group's overall attitudes

3. View of management: interviewees' perceptions of management's attitudes toward technology, and their perceptions of management's abilities and effectiveness

G. Prestige: organizational prestige in Air Force as well as differences in functional prestige

H. Stage: the stage of the product development cycle in which the group works

I. Security: amount of secure data dealt with by the organization, and security measures taken by the organization to protect data

J. Funding: whether the budget is stable, or going up or down; who is responsible for spending budgeted dollars

K. Paper volume: amount of paper required for completion of the work

L. External relations: relations with vendors and contractors, and the technological push or pull involved in the relationship

For each organization, a list of the existing independent variables was developed and the relationship between the independent and dependent variables was examined. Then the individual organizational results were compared with one another to develop an estimation of the overall effects of the environmental and cultural variables on the implementation and usage of office information and communication technologies.

4.4 Field Techniques

Our field techniques consisted of both observation and interviewing; as we gained greater familiarity with SPO routines, interviewing occupied a greater proportion of our efforts. In the field work, a fieldworker would spend anywhere from three days to three weeks at the site, interviewing up to 35 persons, and observing behavior firsthand. Observation was important, because occasionally interviewees would report on the existence of a particular system, such as a document imaging system or a CAD seat; yet close visual inspection would find several layers of dust on the keyboard, and followup questioning would reveal that the system had not been used in the three years since the initial champion left the SPO. From a human point of view, a system that is not used is a nullity.

The use of visual observation was additionally important in developing several of our cultural findings. For example, the casual observation of interaction during a pizza party is informative of the cohesion of work groups and functions, or the indications of division self-image and morale in the decorations of office walls and cubicles.

Our interview protocol is given in Appendix A. This protocol would be administered to anywhere from fifteen to 35 respondents. The interviewer would take extensive notes, as close to verbatim as possible. The interviews themselves were updated nightly, and supplemental material was added to them as it was received. Organizational documents such as organization charts and sections of

briefings were also collected. After the interviewing process was completed, the interviews were transcribed and the interviews were reread. Analysis took the form of content analysis - a process of coding, cross-coding, summarizing, and reaching conclusions about the relationships between variables. Each phrase or phrase group was coded with an identifier that linked this part of the interview to one of the variables being investigated in the project. After coding, for each interview the phrases were grouped by code. Summaries of the cross-coded interviews were made and the summaries were compared and contrasted, to come to overall conclusions about the relationships between communication and information technology usage, and the multiple organizational and cultural variables in the data. These conclusions were condensed, and the findings were reported back to each Air Force organization in a one to three hour out-briefing. This gave the organization a chance to review and comment on the findings before the final cross-organizational analysis. This process was completed for all Air Force organizations studied.

The interviews were conducted according to semi-structured protocols: one set of questions for the front office, and another set of questions for the rest of the people in the organization. These protocols were a guide for the interviews, and were not used verbatim. Probing questions were always used to expand the amount of information collected. The interview protocols were constantly under review during the project, to ensure that the questions that were asked were questions that evoked the data necessary to make the connections between the variables being investigated. At the first, second, and fourth organizations studied, the interview protocols were revised significantly to bring the questions more in line with the questions actually being asked. During the interviewing process at the first and second organizations a third protocol was devised, for management personnel other than the division chief and deputy division chief, which used questions from both previously created protocols. After interviewing at the fourth organization, a new set of questions was formulated, specific to computer support personnel. Further, the variables being investigated were expanded and narrowed as the interview information warranted; some of the variables that were considered significant in the beginning of the project were not considered significant by the end of the project, and new variables, ones not previously considered, were added, and this required constant minor revisions of the questions in the interview guides.

Coding and Analysis

The typewritten notes were then coded. The initial set of codes was based on our Phase I results, being primarily an amplification of the ecological model. As new themes emerged from the interviews, new codes were added and re-applied to earlier interviews. The result was a series of NNN summary interview transcripts, with segments of text -- phrases, sentences, paragraphs -- tagged for different themes.

Once the interviews were coded, they were then cross-coded -- that is, all text segments having the same code were tabulated together. For example, at one site, the following statements were made by different individuals regarding computer support and training:

Statements coded for Computer Support, Training, and Champions, Site ***

"If you had somebody to help you when you're on-line, then it would be good. The computer kicks you off-line after 5 minutes of not hitting a key, so it's hard to resolve problems. We have several people who are knowledgeable about different systems. 2 people I rely on for help are in another building."

no computer training in college of AF except a 2 hour familiarization course which was basically how to turn it off and on.

"Nobody uses the computer to its fullest capability. You live and learn on it. We've never had any class on computer usage so we can't use it to the fullest capacity.

Also training is important - a lot of people are narrow minded and don't see the need for training, but if you keep others from learning the system, then what happens if the person that knows how to do it gets sick?"

"I see *** like that. She's always saying we need this, we need that, and she tries hard to get it. She's always dashing around, I don't know where she gets her energy."

The computer experts in *** make changes and then give training for them."

He has had approximately 5 courses on the computer, about 3 since he came here to the ***. All these courses were specific to his job. "You have to go to these, they have a list of courses you need for your job - we have to be trained for level one acquisitions."

When we have a change in technology they train you for it.

"No one I know is a champion for change. We're all too caught up in our work. New technology comes in when somebody at the Pentagon decides it's time. Who knows who it is."

In comparison with the other SPOs studied, one observes in this SPO a relatively low level of training and support.

From the field investigation we derived a set of management issues. These form an array of operational choices that the SPO director, division chief, or branch manager can have some effect on, and thereby influence the readiness of his or her organization to adopt new systems. As we were

midway through the fieldwork, we realized that we had a choice of pursuing findings that would build an elegant theoretical model, or findings that would be useful to managers:

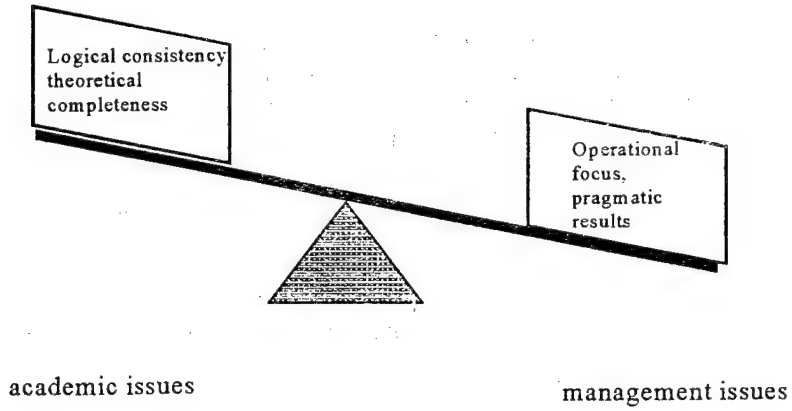


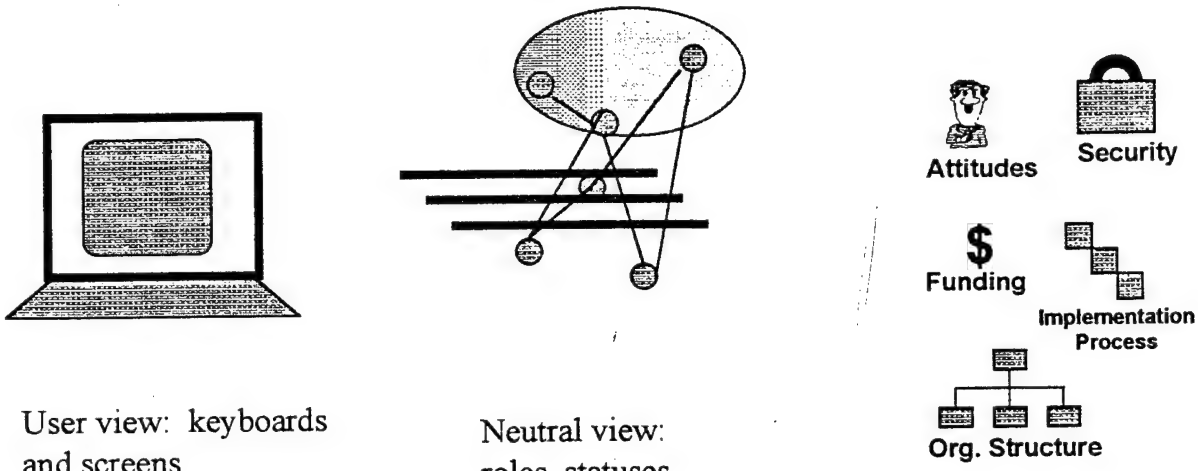
Figure 6 -- Balance of issues

As contrasted to these attributes of the ecological model, the management issues are opportunities for management intervention that satisfy three criteria:

- They are within the manager's scope.
- They represent strategic or tactical choices, which must be prioritized.
- They will have a positive impact on readiness or capability to implement new systems.

One might visualize the management issues in terms of a three-schema architecture, in which the users' behavior and experience on the one hand, and the management issues on the other, are both external views of a common, neutral cultural reality.

FRAME/WORK 3-schema architecture



User view: keyboards and screens

Neutral view: roles, statuses, cultural values, barriers

Management view: structure, process, funding ...

Figure 7 - Three schema view

Our challenge was to create a finite set of management issues out of our research findings. We began with a list of more than 25 coded variables that emerged in the fieldwork. These were then reduced to 19 that had a first-order relationship to implementation success; this list was then reduced to 16 issues that were accessible to management intervention. For example, a variable, "program stage" had a relationship to a work group's interest in new systems, with the more downstream disciplines (particularly logistics) being more favorably disposed to adopting new systems. However, a program manager or SPO director has little influence over the current stage of a program. Hence the finding that program stage bears on attitudes toward new systems, while interesting philosophically, has little practical value.

The management issues that we ended up with are:

- Technology implementation process
- Training
- Cultural assumptions (attitudes) about computing
- User support and diversity of support group
- Levels of usage of computer systems
- Previous experience with computing
- Technology champions and anti-champions
- Communication among co-workers

- Funding
- Job design
- Computer literacy
- Computing and telecommunications policy
- Security
- Organizational barriers and boundaries
- Relationships with contractors
- Physical access to end-user devices

After the set of management issues was created, we created recommendations for each issue. These recommendations were drawn from industry experience, Air Force experience, literature reviews, and a technical interchange meeting held at Armstrong Laboratory.

After the issues and recommendations were codified, they were reviewed by Col. Edward C. Hopkins, USAF (ret.), who made several valuable suggestions regarding them.

4.5 Development of the Readiness Assessment Tool

Parallel with the development of the management issues was the development of the assessment tool. This tool originally consisted of more than 300 questions asked of top management, middle management, users, and MIS specialists. These questions evolved from the interview protocols that we used in our fieldwork. As shown in Appendix A, the interview protocol made extensive use of open-ended questions; the requirement for a forced-response format necessitated a more elaborate set of questions when we built this protocol into the tool. Following the beta test, the questionnaire was revised, and one level of management was eliminated. This revision of the assessment tool cut the time required for the assessment significantly.

A critical issue in tool development was the mapping of the assessment results to the management issues. We considered, and rejected, an indexing approach, where numerical ratings on each issue. This approach was rejected because of the extensive data that would be required to calibrate the indices. Instead we chose to use a backward-chaining mapping of assessment responses to issues. Based on the fieldwork results, assessment questions were mapped to the management issues, and each alternative response was assigned a probabalistic rating for the pertinent issue. Thus, for example, we concluded that if user attitudes were an issue, there was an 0.70 probability that on question 3131, the typical user would give either the first or the third answer. Altogether over 400 pairings of questions and issues were created, with each issue supported by at least six questions.

3132: Which statement best describes the level of computer literacy of people in your work group?

____ The majority of people in our work group are computer literate, and use computers regularly in their work.
____ The level of computer literacy and receptivity to computers in our group is mixed; some people are computer literate and use computers regularly; others do not.
____ The majority of people in our work group are not computer literate and do not use computers regularly in their work.
____ In our work group, more than half of the people may be described as highly computer literate, with advanced computing skills.
____ A few people in our work group, less than half, are highly computer literate with advanced computing skills.
____ In our work group, there are few or no individuals with advanced computing skills.

An important issue in the development of a diagnostic tool such as this is the choice of strategy for anticipating contextual contingencies. These contingencies, of course, are a function of how wide a range of contexts one wishes the tool to address. There is an inevitable tradeoff between:

- **Context specificity** -- to what extent does the tool have context information programmed into it, rather than being collected at run time;
- **Depth of analysis** -- does the tool provide a superficial or insightful diagnosis; and
- **Intrusiveness of use** -- does the tool require extensive data input, or can it issue a diagnosis on the basis of minimal input.

In other words, one can develop a context-neutral tool that is minimally intrusive, but it will return only a high-level diagnosis; if we want an in-depth diagnosis, either the tool must collect extensive information, or else it must be tailored for a specific situation (that is, it has situational information already built into it).

This tradeoff is unavoidable; one could say that successful development of diagnostic tools is a function of finding the right balance among these three considerations, and coupling it with an acceptable user interface.

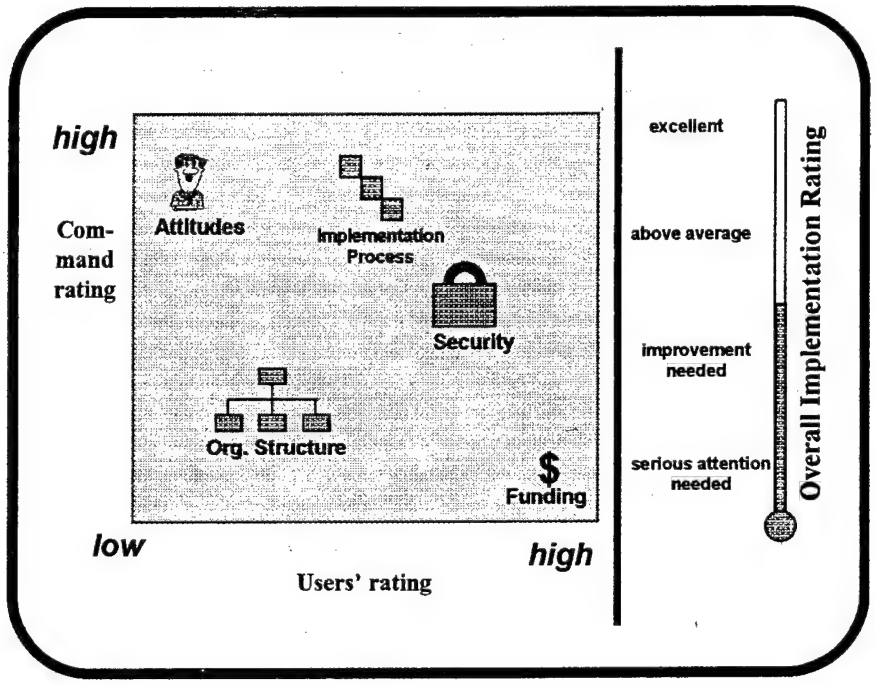
The balance that we struck with FRAME/WORK is:

Context specificity -- tailored to SPOs and by extension military program environments.

Depth of analysis -- one-page briefings, bullet points, on management issues.

Intrusiveness of use -- approximately 4 hours of input total across at least 10 users.

In the beta test the tool reported the top five issues that surfaced as a result of the assessment. Observing reactions to this, we concluded that such a one-dimensional result was at best mildly interesting, and hardly compelling. Following the beta test we revised the report-out of the tool, to compare the command's view of each of the seventeen issues with the users'.



FRAME/WORK Report Screen

Figure 8 -- Report-out screen

In this screen, the thermometer on the right gives an overall rating of the organization's effectiveness in implementing new systems. The two-dimensional grid compares the manager's view of the issue (y axis) with the users' (x axis). The issues are represented by icons, as shown in the legend below. By clicking on an icon, the operator brings up a window summarizing the issue, with hypertext links to the recommendations.

As a result of these post-beta improvements, we achieved our target of creating an assessment tool that could be effectively used by a SPO in two days or less. Current estimates of time required for a FRAME/WORK version 2.0 assessment are:

Setup and configuration	15 minutes
Command configuration	30 minutes
MIS input	30 minutes
Manager & user input	20 minutes each (minimum 10 recommended)
Review results	30 minutes

Summary of Development Strategy

In sum, the FRAME/WORK development achieved an integration of inductive, empirical field research, conceptual synthesis, and engineering development. It achieved this through successive refinements of the model of SPO culture, the assessment instrument (first embodied in a paper questionnaire and later in the software tool), and the actual FRAME/WORK tool:

Our approach to the FRAME/WORK development could be summarized as "making social science work for management." There is a strong science base underlying the tool; as shown in section six, there are many interesting findings embedded in the tool. Careful fieldwork and data collection went into developing these findings. Yet our goal was not so much to be interesting, as to provide a useful tool. This required that the science and the findings be packaged in such a way as would be feasible from an engineering point of view and useful from a management point of view. We submit that the resulting tool meets these tests.

The approach we created strikes a balance between an academically-thorough description of technology implementation concepts, and an adaptation of these concepts to the pragmatic concerns of the SPO director or division head. The basic components of the tool -- the assessment instrument, the expert system, and the issues report -- are all derived from or grounded in field research and the social science literature of technology implementation.

5. Research and Development Activities

Our research activities in the FRAME/WORK tool development embraced parallel efforts to refine a model of SPO culture, develop rapid assessment instruments for assessing the culture, and embodying this instrumentation into a software tool. Significant attention was given to assuring that the tool would be optimally useful to AFMC managers.

5.1 Project Overview

Phase II of the FRAME/WORK research was conducted from October 15, 1993 to June 30, 1995. The project team consisted of the following personnel:

Dr. Allen Batteau	Director of Research, Wizdom Systems, Inc.
Dr. Marietta Baba	Professor of Anthropology, Wayne State University
Ms. Crysta Metcalf	Graduate student in Anthropology, Wayne State U.
Ms. Kathy Fell	Graduate student in Anthropology, Wayne State U.
Mr. Francisco Pulgar-Vidal	Project Engineer, Wizdom Systems, Inc.
Mr. John Conway	Senior software engineer, Wizdom Systems, Inc.
Dr. Zhen Gang Li	Software engineer, Wizdom Systems, Inc.

Contract support for reviewing project materials was additionally provided by Col. Edward C. Hopkins (USAF, ret.), and Ms. Julia Gluesing, a graduate student in Anthropology at Wayne State, and a member of the Phase I team.

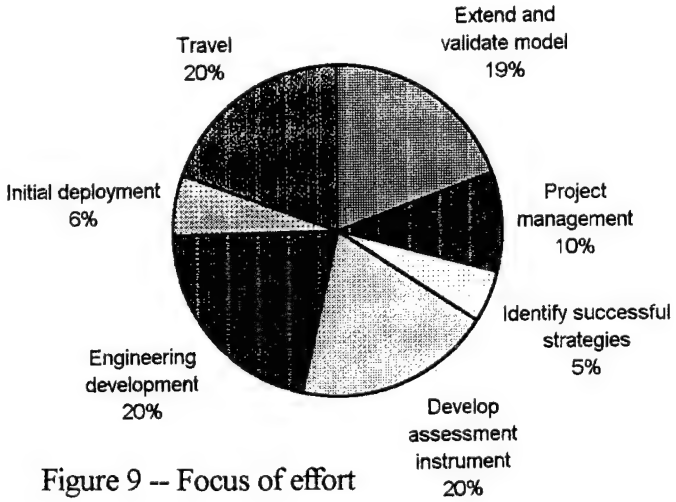


Figure 9 -- Focus of effort

The dominant activities in the project, as illustrated in the pie chart above, were extending and validating the ecological model, developing the software instrument, and engineering development of the FRAME/WORK tool. Other activities included identifying successful implementation strategies, identification of USAF applications, and the beta test of the tool.

Two events in the third and fourth quarter of 1994 events created unavoidable schedule delays. The first of these was some integration problems in the software development. This pushed beta deployment, which had originally been scheduled for August 1, 1994, back to early January 1995. A successful beta launch was achieved in January 1995 at two ESC directorates.

The second problem was the acceptance by the Principal Investigator of a professorship at Wayne State University, beginning in January 1995. This resulted in stretching out the beta deployment, and delaying the final software modifications. Neither of these events is judged to have had an adverse effect on the overall quality of the final product.

Significant attention was given to briefing the project to field sites, beta sites, and other groups. Figure 10 on the next page lists all of the briefings conducted during the course of Phase II.

Date	Location	Component	Key contact	Type of briefing	Result
12/6/93	Wright-Patterson	ASC/RE	Col. Bednarz	Outbriefing	Reported on findings at RE
12/7/93	Kelly AFB	ASC/LAA	Mr. Martinez	Kick off field research	Fieldwork initiated
12/8/93	Eglin AFB	ASC/VL	Col. Dickson	Establish new field site	
1/14/94	Wright-Patterson	AL/HRGA	Captain Smith	Phase II Kickoff	
1/25/94	Hanscom AFB	ESC/AV	Matt Mleziva	Request for fieldwork	Fieldwork set up
2/3/94	Wright-Patterson	ASC/YP	David Gentry	Request for fieldwork	Fieldwork set up]
2/22/94	Wright-Patterson	ASC/SMGH	Col. Saliba	Request for fieldwork	
2/23/94	Wright-Patterson	ASC/RE	Col. Bednarz	Summary outbriefing	Combined RE & Det-8
3/1/94	Kelly AFB	ASC/SA	Ray Ranzo	Request for fieldwork	
3/1/94	Kelly AFB	ASC/LAA	Mr. Martinez	Preliminary outbriefing	
4/21/94	Hanscom AFB	ESC/MS	Joseph Mardo	Request for fieldwork	
5/11/94	Wright-Patterson	Armstrong Lab	Capt. Bob Smith	Quarterly Review	
5/11/94	Wright-Patterson	ASC/CY	Keith Pickleheimer	Outbriefing	
5/11/94	Wright-Patterson	ASC/VL	Col. Dickson	Assessment briefing	LANTIRN set up
5/13/94	Wright-Patterson	ASC/VL	Lt. Col. Zlotkowski	LANTIRN request	
9/13/94	Wright-Patterson	Armstrong Lab	Capt. Bob Smith	Quarterly Review	
9/27/94	Kelly AFB	ASC/SA	Sam Idrogo	Request for fieldwork	
12/6/94	Warner Robins ALC	Det-8	Col. Cole	outbrief of Det-8	
1/4/95	Hanscom AFB	ESC/JS	Major Carol Jones	Joint Stars outbriefing	
1/4/95	Hanscom AFB	ESC/AV	Capt. Wituzynski	Comm& Control outbrief	
1/19/95	Wright-Patterson	Armstrong Lab	Capt. Bob Smith	Quarterly Review	
1/19/95	Wright Patterson	ASC/CY	Dwight Early	discuss beta site	
1/19/95	Wright-Patterson	FACTS	Col Saliba	outbrief	
1/26/95	Eglin AFB	ASC/YH	Col. Sullivan	outbrief conv muni	

Figure 10 -- FRAME/WORK briefings

5.2 Extending and Validating Model

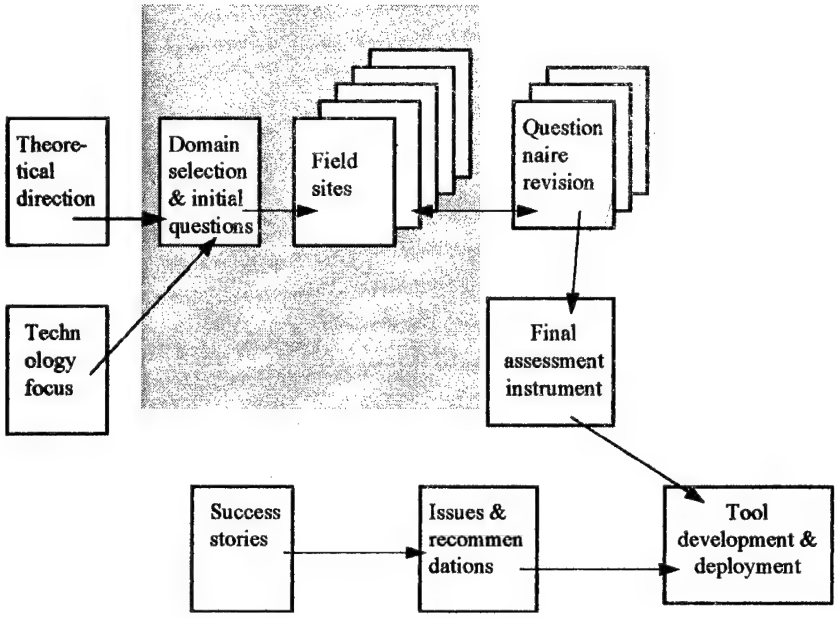


Figure 11 -- Extending and Validating the Model

The original findings of Phase I were based on a single SPO within ASC. This case study provided a good foundation for further model-building in AFMC. Building on this, a lead task in the research was to find a sufficient number of SPOs and ALC components to extend our basic model of cultural impacts on implementation. To do this, we undertook, from March 1993 to January 1995, fieldwork in 11 different AFMC organizations:

Recon System Program Office (ASC/RE)
C17 System Program Office
Det-8 of Recon
C-17 Site Activation Task Force (ASC/CY-LAA)
LANTIRN System Program Office
Contractor
F16 System Program Office
FACTS Program
Joint STARS Program Office (ESC/JS)
Command and Control Program Office (ESC/AV)
Conventional Munitions Program Office (ASC/YH)

These research sites and our original fieldwork in the Subsystems SPO (ASC/SM) form the basis for our model of SPO culture and technology implementation.

Our efforts to gain access at an ALC were unsuccessful, despite two trips to one specific ALC to brief responsible managers. We did, however, conduct research in two SPO components located at ALCs; these, together with interviews with maintainers at another ALC gave us insight into some of the critical differences between SPOs and ALCs and the general applicability of our findings.

Two of these sites did not yield usable findings: in one, the commander who had given us permission to conduct the study was re-assigned just before we began the fieldwork; interviews with personnel in this organization turned out to be perfunctory and superficial. In another organization, a major suspense interfered with the fieldwork, also resulting in unsatisfactory interviews.

Site recruitment

Field sites were recruited in a variety of ways. Four of the sites came through personal referral from our initial contact at the Subsystem SPO. One site asked us to come in and conduct an assessment. Five others were the result of a letter sent to all SPO directors in ASC and ESC requesting a research opportunity. In every case, after the initial contact we presented a briefing to the SPO director or his designate. The briefing included a request for the research opportunity. Typically at the end of these briefings a point of contact was designated, and the researcher arranged scheduling with the POC.

Interviewing and SPO observation

Fieldwork for the study involved interviewing 138 people individually, and 74 in group interviews. Many of these people were conferred with more than once in order to validate the findings from the interviews. The interviews lasted from one to two hours on average. Interviewees were asked to speak on a number of topics related to their use of information and communication technologies, other people's use of these technologies, and their organizational culture. Except where precluded by security considerations, the interviewer was given tours of the organizations, and work relationships and the physical environment were observed before, between, and after the interviews.

A number of observations were made in each SPO. In Appendix E we report on our observations and findings for each SPO. These are the observations:

- Illustrate the qualitative nature of this research, and the organization of visual data and unstructured observation to elucidate cultural patterns
- Document the enormous variability of local cultures within AFMC.

Such issues as the physical layout of workspaces, a pizza party, or the decorations on an office wall, are important indicators of work processes, social relationships, and organizational morale.

The fieldwork supporting both the FRAME/WORK tool and the findings of this report was unusually thorough. The combination of structured interviewing and unstructured observation yielded a rich set of findings, which are presented in section 6.

5.3 Identify Successful Strategies

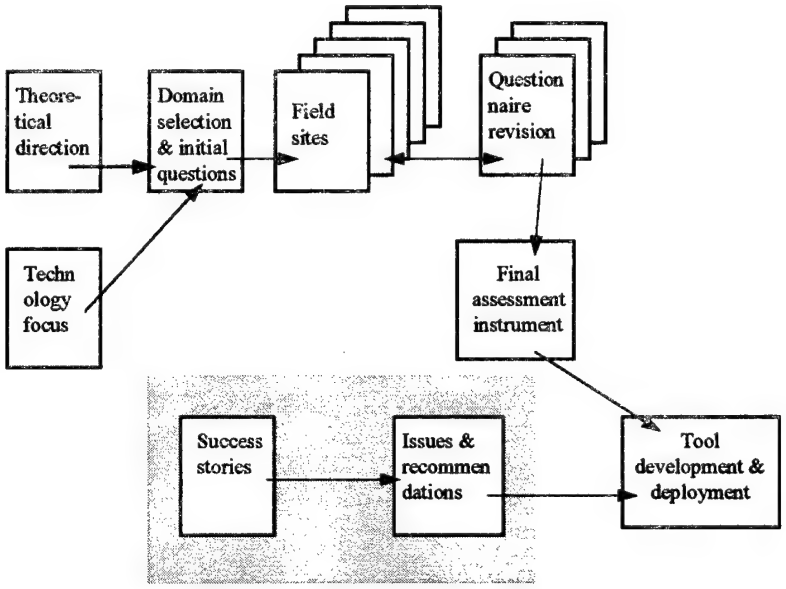


Figure 12 -- Identifying successful strategies

Four initiatives were undertaken to identify implementation strategies for dealing with human issues in systems implementation:

1. Contacting CALS shared resources centers and CALS vendors
2. Literature review
3. Industry experience of the team
4. Technical interchange meeting of ASC MIS personnel

In January, 1994 the PI contacted the CALS Shared Resources Centers (CSRCs) to elicit any success stories they would have regarding CALS implementation. Although, as explained in the previous section, our focus was larger than CALS, we judged that CALS was a useful heading for identifying the class of work-process-changing technology we were interested in. Three of the CSRCs responded, and eight leads were developed for success stories. These were pursued, and through interviews developed into narrative form. The success stories have been embodied in the tool linked to the recommendations.

A second approach to successful strategies came from a review of the literature on the implementation of information systems. Some of the leading sources supporting the recommendations in the tool include Adler 1990, Baba 1995, Handy 1995, Majchrzak 1992, and Taylor and Felton, 1993.

Related to this was a third approach, the use of industry experience with systems implementation. The senior members of the team (Dr. Batteau & Dr. Baba) have both had several years experience in consulting on human issues in implementation, and have from time to time prepared briefings and reports on human and cultural factors. This experience and material was available to the project and was used where judged appropriate by the PI.

As a final approach, on July 20, 1994 the Armstrong Laboratory (in its electronic meeting facility) hosted an informal information exchange to which were invited all the MIS managers from ASC program offices. Approximately 12 individuals attended this event, and using the electronic meeting facility produced a 20-page transcript discussing examples of successful implementations, barriers to implementation, and the critical success factors in implementation. These examples are discussed in section 6.

5.4 Create Assessment Instrument

Creating an assessment instrument was perhaps the most challenging part of this project. This stems from the fact that the variables we wanted to assess -- user and organizational readiness for and barriers to systems implementation -- are far from standardized. There is no canonical statement of the barriers or readiness factors in the literature. There is consensus on some issues, such as the need for champions; on others, particularly those that are specific to the military (such as the security issues), there is nothing written. Even when there is consensus on an issue, there are no standardized measures for the issue. The empirical, inductive approach used in developing the FRAME/WORK tool provided a significant resolution of this difficult issue.

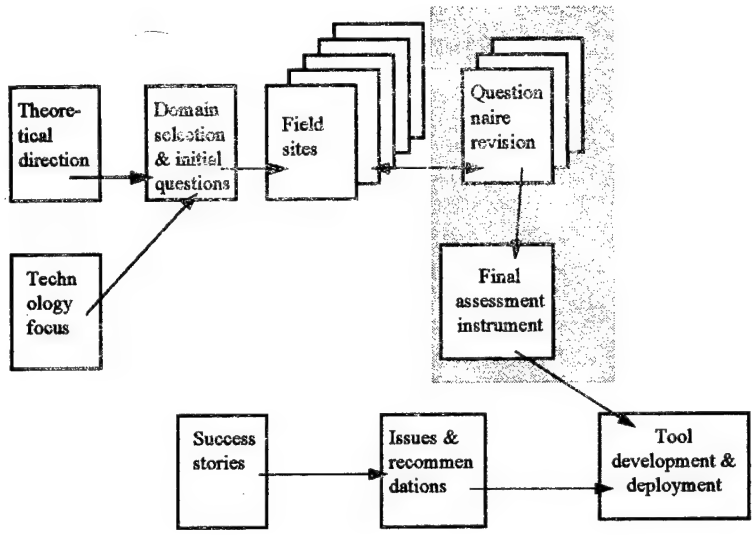


Figure 13 -- Developing the assessment instrument

Developing the Questions

Questions for the FRAME/WORK tool were created based on the interview protocols used during the field research. Some questions, which were found to produce little predictive data, or which could not be transformed into closed-ended questions, were eliminated. Other questions had to be rewritten, sometimes making one broad question into three or four more specific questions. It was ensured that a range of questions, specific to each significant predicting variable, were asked. Once this was accomplished, possible answers to each question were gathered from the data, shortened, and inserted as answer choices. This process of gathering possible answer choices from actual answers in the interviews allowed the answer choices to reflect variability while establishing validity. The questions were then linked to issues which reflected the management significance of the variables.

The questions were linked to issues through Bayesian logic rules. These logic rules consisted of probabilities which expressed the likelihood of any given answer being associated with the particular issue that was linked to the question. For each issue it was asked: in how many organizations was this issue important? From this came the initial probability for the issue to occur in any Air Force organization. Then it was asked: of the organizations with this issue apparent in them, what percentage of people were likely to choose this particular answer?

It was then asked: in organizations which did not display this issue, what percentage of people were likely to choose this particular answer?

From the answers to these two questions, based on the fieldwork experience, came the Bayesian logic probabilities - the probability that any particular answer would be common or uncommon in an organization with the issue, common or uncommon in an organization without the issue. For answer

sets whose members were mutually exclusive, the probabilities had to add up to 1.0. For answer sets whose members were not mutually exclusive, the probabilities did not have to add up to 1.0.

The Liveware Session

A rare and valuable opportunity to test some of the concepts was afforded by the Reconnaisance SPO in April 1994, when they agreed to host a real-time test of the questionnaire and evaluation. The team traveled to Dayton on April 7, 1994, and met with ASC/RE personnel for approximately four hours, asking personnel at all levels the different items on the questionnaire. This yielded some important refinements of wording and focus. The original intention of this session was to give the personnel present feedback on the team's conclusions of the assessment; however, the session was interrupted by a toxic gas leak in the area, which forced an evacuation of the entire building. Accordingly, this report-back was conducted by teleconference a week later, with valuable results: SPO personnel found the conclusions meaningful and "something to think about".

Following this session, further refinements were made in the assessment questionnaire, which along with an expert system linking the assessment to the management issues, was developed into the FRAME/WORK tool.

5.5 Engineering Development

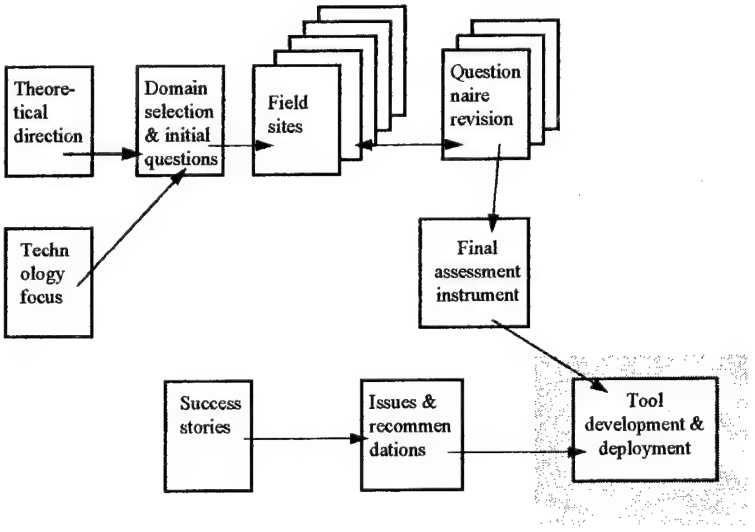


Figure 14 -- Engineering development

Engineering development of the FRAME/WORK tool began in December of 1993; the first beta release was in December of 1994. A requirements document outlined a basic set of requirements in

terms of collecting user information (the assessment), analyzing user input, and presenting a set of results to management.

Below these basic requirements were a number of design issues involving tradeoffs between the intrusiveness of the assessment, the level of analytic detail, and the nuancing of management recommendations. These issues were resolved through team meetings involving both the field researchers and the software developers.

A more detailed design description of the tool is given in Appendix C.

5.6 Initial Deployment

After the first working version of the FRAME/WORK tool was assembled, copies were sent to USAF SPOs that had volunteered time to conduct initial testing activities. In the software development lifecycle this phase is called "beta testing."

The initial list of beta sites consisted of:

Conventional Munitions SPO (Eglin AFB)
Command and Control SPO (Hanscom AFB)
Reconnaissance SPO (WPAFB)
J-STARS SPO (Hanscom AFB)
F-16 SPO (WPAFB)

Due to scheduling difficulties and the reassignment of personnel, full beta tests were completed only at the first three of these.

Conventional Munitions SPO

At this site the tool was tested by the MIS manager. This manager decided that only he should test the tool, inasmuch as earlier beta tests of other tools had left his users disappointed. His organization had just finished a compulsory survey, and he judged the time not opportune for any further interruptions in the daily work.

One of this manager's most important observations was that the language used in the questionnaires was too generic or obscure, and that the MIS person should have the ability to include the right wording so that users would not be faced with confusing questions. For instance, users who routinely use workflow tools without realizing the nature of the tools (seeing them as part of an e-mail suite), would be at a loss when asked about the frequency of use of a workflow tool. If MIS had had the

opportunity to replace "workflow tool" in the questionnaire with the name of the application familiar to the users, the responses would have been more accurate.

Also, the current structure of the tool favors an order for data entry that closely resembles the organizational hierarchy. Although this is helpful in the organization of the questionnaire,, it presents a usage hurdle: data entry at the user level needs to wait until hard-to-get personnel at the directorate and division have entered their data.

He also made the remark that some of the answer choices provided were ambiguous or were not uniformly graded, and asked that the MIS person be able to fill in some of the "other" choices.

These recommendations were incorporated into the subsequent beta version, which was then tested at Hanscom AFB.

Command and Control SPO

The SPO Executive Officer was the team's point of contact at Command and Control. He assembled thirteen users to test the assessment tool, including the SPO director and the computer specialist. The total number of users answering the questionnaire was eleven.

The two most important observations at this site are: First, the language used in the questions and answer choices was too general, or too "techie" for some users, with too little reference to actual packages. This was despite some modifications made in response to the previous beta test. The team was told to write at an easy-to-understand level. Second, the questions needs to be better tuned to the level they are targeted for, and some indication should be made regarding from what viewpoint the respondent should answer the questions.

Other observations included: not liking the answer choices, black or white alternatives instead of a gradation, aggravating navigation commands, and that the system should be on-line because it is too difficult to bring people to "the" PC.

Reconnaissance SPO

The MIS manager and Mr. Francisco Pulgar-Vidal assembled fifteen people to test the tool, including the director, five subdivision managers, and the computer specialist. The total number of users answering the questionnaire was eight, including one anti-champion.

At this beta test we observed user sessions as they happened, rather than being briefed on them later. Most users, including senior personnel, got used to the user interface during the first few screens, especially when told about keyboard shortcuts. Some personnel performing more than one assignment had difficulty knowing which viewpoint to use to answer some questions. At times the answer choices

provided would not satisfy a respondent: he or she would have liked to answer "none of the above", but there was no such possibility. Questions asking for number of contractors did not specify number of firms or number of personnel. Users would at times complain that the questionnaire was too long, and would observe that a duration of fifteen to twenty minutes was the practical limit.

5.7 Integration with non-CALS systems development

Two activities were undertaken to investigate the integration of the FRAME/WORK tool with military systems development and implementation. The FRAME/WORK team has reviewed DoD Directives 8020.1, 8320.1-M, 8320.1-M-1, 8320.1-M-x; these documents describe DoD procedures for systems development and implementation. Based on this review, we have identified nine areas in DoD procedures that would be supported by the FRAME/WORK tool. These are described in section 8.

Additionally, at the suggestion of Joint Stars personnel (ESC/JS), we investigated the manner in which the FRAME/WORK tool could be integrated with JIMIS (Joint STARS Integrated Maintenance Information System), a portable maintenance aid scheduled for initial deployment in November 1995. The PI was briefed on JIMIS by a JS MIS manager and by contractor personnel at Melbourne, FL; additionally he was briefed on IMIS concepts by HRGA personnel, and flight line issues by a former flight line supervisor. Four critical cultural issues -- history of implementation, turbulence, organizational barriers, and job design -- were identified that could lead to user resistance in the JIMIS deployment; these are discussed in the more general context of PMA devices in section 7.

5.8 Conclusion

As can be seen, the research and development on FRAME/WORK consisted of multiple activities undertaken in parallel. This enabled the rapid transition of basic science findings (the effects of SPO culture and context on IT implementation) into a practical tool. As will be evident in subsequent sections, this science base has potential for practical application well beyond the FRAME/WORK tool.

6. Research Findings

The findings from the FRAME/WORK research have three purposes. One purpose is to enlarge our understanding of the integration of sociotechnical systems. Members of the FRAME/WORK team are preparing scientific papers for publication in scholarly journals that will make a significant contribution to the literature of sociotechnology. The second purpose is to provide practical information to the Air Force regarding information technology management practices. The third purpose is to support the development of the FRAME/WORK readiness assessment tool.

We present here three types of findings:

- General findings of patterns that, while observed at the SPO level of organization, have broader implications for AFMC systems implementation policy. These include the levels of implementation, the perceptions of levels of implementation, and the role of management.

- The effects of the external and internal SPO environment on implementation; these are issues such as program definition and infrastructure which the SPO has some, but not exclusive leverage over.

- Issues that bear on the sociotechnical integration of the SPO -- how well its social system meshes with its technological infrastructure. These are issues over which the SPO director has significant leverage.

6.1 Findings with broad implications for AFMC

This first set of findings, like the others, is derived exclusively from observations inside the SPOs. These findings, however, have broad ramifications for AFMC information technology policy.

Finding #1: Levels of IT usage in the SPOs fall short of DoD paperless objectives

Compared to DoD objectives for highly automated and paperless environments, office information and communication technology usage is low in a majority of Air Force organizations. Computers tend to be used for word processing and E-mail in most of the organizations, even the lowest use ones. Shared databases and workflow tools are common in many of the organizations studied, but the quantity used, number of people who use them, and the frequency of their use is, more often than not, very limited.

Video teleconferencing is available in most organizations, but it is used, in most cases, only by a minority of organizational members. Use of electronic data interchange and document imaging is almost non-existent even in the highest usage organizations, and CAD/CAM systems are hardly used at all.

Finding #2: Perceptions of IT usage levels correlate inversely with actual levels

Interestingly, personnel in high usage organizations may have a tendency to consider their organizations low usage organizations, while members of low usage organizations may feel they have higher usage levels than they do, compared to the rest of the Air Force. This is potentially related to where new organizational members are recruited from. In some organizations, new people come from organizations that had less, or approximately the same amount of office technology usage, while in other organizations, the new recruits come from computer automation test sites, far more automated than the organization into which they are moving. This history biases the viewpoints of each group - even in a high usage organization, members who came from a higher usage organization will interpret usage levels as low, and in a low usage organization, members who are used to this level of usage, or come from even lower usage organizations will interpret usage levels as high. In other words, interpretation of computer usage levels is based on previous experiences. If you recruit people from low-use organizations, other low to medium-use organizations will look like high-use organizations; if you recruit from high-use organizations, other high to medium-use organizations will tend to pale in comparison.

Finding #3: The biggest bottlenecks to CALS implementation are above the program office

Very early in our study we discovered that SPO personnel were more mystified than enthused by CALS. "A dreamsheet" was one characterization we heard. To the extent that SPO managers were familiar with CALS concepts, the general attitude was that it was a good concept, but they had more critical problems facing them. Overall there was little understanding of the concepts because they were not perceived as having any criticality.

Finding #4: Aggressive implementation strategies work best

The rapidity of implementation correlates strongly with organizational usage levels. The more people who start using the technology at the same time, the more useful this information and communication technology tends to be. If only ten people in a two hundred person single program office are hooked together in order to communicate and share information with one another, they will experience this technology as far less useful than they would if they could communicate with everyone in the organization. If only small numbers are hooked up initially, and implementation is slow, the initial users may discontinue their usage of the technology and share their lack of satisfaction with other organizational members. This reduces the likelihood of successful implementation. In other words, the

more quickly the number of people who have and use the technology comes to a critical mass, the more likely the success of the implementation. The more people use the technology, the more others will be encouraged to use it, in a self-perpetuating, snowball effect.

This finding is particularly significant in light of the frequent pressures to deploy (or at least announce) new systems before they are technically mature. Rapid deployment of immature systems is self-defeating; extended deployment of immature systems, of which there are many examples, tends also to give the program a bad reputation.

Finding #5: IT implementation presents a management challenge

Active management resistance to office automation technology can hinder organizational attempts at implementation and usage, especially if the management anti-champion is in a position to prevent implementation and/or usage, but managerial resistance can also be overcome by a receptive overall culture and a computer support group that champions new office technology actively. In general, management viewpoints do not tend to correlate with organizational usage levels. Management personnel were seen as unreceptive in most organizations, and in others as not pushing office technology implementation or usage. In only one of the organizations studied was the management viewed as receptive. In many organizations, the management personnel were reported as the group who used office information and communication technology the least, even in the medium and high usage organizations. The relatively slight role of management attitudes may be attributable to the length of tenure usually experienced by personnel in management. Air Force officers change locations frequently, and a temporary resistance is much less influential on the organization than a permanent one. If these people have spent most of their military careers performing their work manually, there would be resistance to changing something that has worked well for them in the past, but they usually do not actively bar their subordinates from using the technology. They simply do not lead by example, which is not as much of a hindrance as active anti-championing efforts.

Leadership is an important aspect in the implementation of office information and communication technology, but leadership in this arena appears to be more important if it comes from computer support personnel or from informal champions of technology change, rather than from the SPO directors. Computer support and other personnel are, many times, more permanent than directors. When directors change, policies change with them, including at times office technology policies. The changes introduced by new directors will often have limited time to gain support. The systems that are stable, well-established, and have widespread organizational support will continue to be used. These systems will be systems introduced and championed by personnel with long histories of working in the SPO.

Finding #6: In the Air Force culture, engineering and office automation are not perceived as mission critical

The Air Force's sense of mission and purpose, which recognizes defense of the nation as its raison d'etre and views fighter pilots, fighter planes, and engines as most vital to that mission, has an influence on technology change. While computer-aided design technology does directly benefit the design of fighter engines, the operation of such technology is not the responsiblity of the Air Force engineers, but of outside suppliers. Therefore, a dynamic force for technology change in industry (i.e., the evolution of CAD technology) is absent in the Air Force.

6.2 Findings regarding the environment of SPOs and SPO work groups

The SPO environment contains numerous features over which the SPO director has partial leverage. For some, such as the turbulence of the AFMC environment, he can, at best, mitigate its effects; for others, such as the age of physical infrastructure, change can be part of a long-range strategy.

Finding #7: Turbulence within AFMC is a major inhibitor to IT implementation

At the time of the interviewing, the Air Force as a whole was going through both extensive and intensive changes. Funding was decreasing, a mandatory force reduction (downsizing) was occurring, bases were closing, and the organizational structure as a whole was being altered. Acquisition and sustainment organizations, which had previously been autonomous and under separate command structures, were being combined under the auspices of IWSM (Integrated Weapons System Management) to produce "cradle to grave" project management in the product development cycle. As part of this change, the organizations which were combining under one authority structure were also responsible for a change from a formal organizational structure based on functional groupings, to an organizational structure based on IPTs (Integrated Product Teams), which are groups that combine all the functions necessary to complete a project or support a product. These changes were having a major impact on personnel in the organizations studied. Stress, fear, and lowered morale were the resultant outcomes, with some organizations being more affected by these attitudes than others. Members of some organizations felt themselves more at risk than members of other organizations, based on the centrality of their organizational missions to new (post cold war) Air Force objectives. This resulted in some organizational cultures being more change averse than other organizational cultures, due to the members' association of organizational change with personal risk.

This turbulence had an affect on the implementation of new office information and communication technologies. Organizations which had experienced greater than average turbulence, especially if members perceived a high degree of association between organizational change and personal risk (especially job loss), were averse to technological change as well. This can be seen in the data, with medium to medium/high usage organizations experiencing less turbulence and associating these changes less with risk, than low to low/medium usage organizations. High degrees of turbulence also

affected the amount of time and energy available to cope with technological implementation and learning. Concentration is focused on the changes occurring, instead of implementing, learning, and using new office technologies. In many instances it was reported that the extent of information and communication technology usage was a factor of how many people were left after downsizing, and the amount of work required of them. Personnel with extremely high workloads (people doing the work of more than one person) did not have the time to learn a new system, it was easier and faster to accomplish their work using familiar methodologies. Learning how to use a new office technology requires an investment in time that is often not available to personnel with more to do in a day than can be done. Organizations that had already successfully automated their office work processes, and then lost personnel, would not be affected by this phenomenon.

Finding #8: Single Product SPOs can better implement new IT

Organizational mission, as far as acquisition versus sustainment, was not correlated to usage levels. Acquisition organizations had both very high, and very low, as well as medium, usage levels. This was also true of sustainment organizations.

The formal organizational structure was almost identical at every organization studied. SPOs (System Program Offices) were two-letter organizations and contained sub-units denoted by three digits (three letters or two letters and a number). These three-digit organizational sub-units were broken down further into groups specified by four-digits. Variation in usage levels, then, did not correspond to variation in formal organizational structure.

Variation in usage levels did correspond, however, to the number of products worked on by the organization. Single program SPOs were more likely to have medium to medium/high usage levels than basket SPOs or basket divisions of basket SPOs. Basket SPOs have a number of programs that are usually autonomous, requiring little or no communication between product or project groupings. Also, each program frequently has its own special communication and information technology needs: specific systems that are necessary or unnecessary for specific kinds of tasks. These qualities of independence, along with the fact that basket SPO programs often were responsible for their own resources, and could purchase software independently of the other programs in the SPO, made widespread implementation of universal, communal information and communication technologies difficult. Furthermore, usage levels will be at a lower level in these organizations simply because of the lack of need to communicate or share information with other SPO groups.

As stated previously, teams in each organization tended to be cross-functional and based on an IPT structure due to the change to IWSM. This did not mean functional teams were non-existent, but that IPTs were forming, and becoming the majority. This was true in most of the organizations studied, and thus presence of IPTs could not be found to correlate to organizational usage levels.

Finding #9: Social and physical infrastructure affect IT implementation

The age of the organization did correspond to usage levels. For the most part, the pattern showed that the older the organization was, the lower the usage levels it had. This can be attributed to well-established practices of using manual techniques. Once manual techniques are perfected, and they have been proven successful in completing the required work, their use becomes ingrained in the culture, and it is much more difficult to change to automated office technology. If office communication and information technologies are implemented before manual methods have time to become entrenched, they will be received with less resistance and will be used more frequently. A young organization that waits to implement office automation technology is at risk of losing their advantage: once manual methods are established and proven successful, it is possible to develop a cultural attitude of "if it ain't broke, don't fix it."

The physical environment of the organization is also correlated to usage levels. The less infrastructure already in place in the building, the less capabilities there are available, and the longer implementation of new technologies takes.

Finding #10: Perceptions of attitudes affect receptivity

Whether someone can be persuaded to accept and use new office automation technology has more to do with their perceptions of other people's attitudes about the technology than it has to do with their individual attitudes about the technology. If organizational members perceive others as resistant to new information and communication technologies, they are less likely to use the technology. If people perceive a receptive office culture, they are more likely to accept and use new information and communication technologies, and the opposite is true as well. An individual, him or herself, may have very positive attitudes about office information and communication technologies, but if the organizational culture portrays negative attitudes and resistance, this individual is unlikely to buck the system, so to speak. The data collected supports the finding that even champions can end up as low level users with negative attitudes after being in a low-use organization with high resistance.

Finding #11: A moderate level of fragmentation is a facilitator of IT adoption

A certain degree of fragmentation seems to be conducive to acceptance and usage of office information and communication technologies. When organizational members must cope with frequent TDYs, and/or the necessity of communication with remote locations (organizational members located out of state), this increases the likelihood of a high usage level of communication technologies such as E-mail and video teleconferencing. In other words, collocation can actually hinder some implementations, instead of helping them. When people can simply push their chairs back and talk to each other (or communicate via the VLV - Very Loud Voice - method) they will be less likely to see the need for learning to use office information and communication technologies. Communication within every organization studied took place on an ad-hoc, as needed basis. There were regular meetings, but often

a number of people could not attend these meetings because they were on TDY. While most communication took place face-to-face or over the telephone, communication technologies were expressed as especially handy for leaving messages for people who were out of the office. The more frequent the TDYs experienced, the more E-mail was considered a necessity for organizational work.

On the other hand, when different but connected organizations are located far apart, the organizations tend to drift away from one another. Non-collocated organizations may be at very different levels of usage, despite their connection and frequent communication. As each organization focuses on its own issues and needs, and develops its own methods for accomplishing the mission, the feeling of connectedness dwindles, and may even spark negative feelings toward other organizations connected to them via the command structure. This adds to the variability between organizations. Just because two organizations report to the same central authority figure, it cannot be assumed that they have similar acceptance and usage levels of office automation technology.

6.3 Findings related to SPO sociotechnical systems

This last set of findings, based in sociotechnical systems observations, relates to issues that a SPO director has leverage over. Whether through training programs to encourage different attitudes, the structuring of computer support groups, or the use of incentives to overcome the legacy of previous implementation efforts, these findings point to issues that are uniquely the concern of SPO management.

Finding #12: Individual attitudes do not correlate with usage levels

Individual attitudes towards office information and communication technology are very positive in low usage organizations, become more negative in low to medium usage organizations, and become more positive again with medium to medium/high usage organizations. In each medium, and medium/high usage organization the percentage of negative attitude statements about technology was almost as high as the percentage of positive attitude statements. These results actually correspond to the number of specific problem statements being reported by office technology users. Low usage organization members make few specific problem statements because they use such a small amount of technology. Low to medium use organizations are usually having implementation problems, thus the increase in problem statements, and medium to medium/high usage organizations are using so many different systems that problems are not only bound to appear, but are bound to be noticed and commented on because of the organizational reliance on the technologies for the completion of their work.

Taken together, findings #7 and #8 present an interesting conclusion and an interesting opportunity. Our data indicate that it is not so much the individual's attitude toward the systems, as it is his or her perceptions of others' attitudes, that affects his or her willingness to try new systems. This means that

if management can cultivate a culture of receptivity, through leadership, example, communication, and the isolation of anti-champions, then the individual users will accept the new systems.

Finding #13: The support group is critical

Perhaps the most important variable, with respect to the success or failure of office information and communication technology implementation, is the computer support provided before, during, and after the implementation effort. This is the key to creating receptivity, maintaining receptivity, and quashing resistance. The computer support group is responsible for the history of technological change, the change process, the change plans, and training.

The culture of the military makes it such that if the computer support group is large, and diverse in both gender and ethnic background, the computer support group will be more successful. Three of the top four organizations in office technology usage levels had large, diverse computer support groups. The Air Force population as a whole is diverse, and when this is also reflected in the computer support group, personnel are more able to find compatible personalities to aid them in learning and using the systems.

Furthermore, the study indicated that the computer support personnel must be knowledgeable about system usage as well as system implementation. All four of the top usage organizations had computer support groups that could assist users, not only in getting their information back if they somehow deleted it, or getting back on-line if they went off-line, but in day to day questions about usage methodologies as well. When computer support personnel do not know what the systems are used for, or how to use them, the organization often reflects this in low-level usage patterns.

Training is also important in the success of information and communication technology implementations. Just-in-time training was reportedly the most effective. Training too far in advance allows personnel to forget key information and training after implementation allows personnel to experience lack of usefulness, both of which are detrimental to receptivity. Most of the training, except in the highest usage organizations, was not just-in-time, but was conducted either far in advance of implementation or after the fact. Furthermore, the training must be appropriate to personnel capabilities. If training is too basic, or too advanced, it will not be useful. Training that was too basic was indicated to be a problem in some of the organizations studied.

Finding #14: A history of failed implementation is difficult to overcome

When the history of office automation technology implementation includes failures, it is much more difficult to implement subsequent systems successfully. Organizational members retain a memory of the past failures and are likely to expect this implementation effort to go the way of the other efforts - down the tubes. Organizations with large numbers of resistant personnel may find that members try to simply wait it out, believing that if they delay learning and using the system long enough, it will

eventually pass away or be replaced by something new, much as other organizational fads. We found the best predictor of future success in implementation was a good track record. Some organizations were always stumbling, while others were consistently successful in their implementation efforts.

Finding #15: User input facilitates implementation

If the technological change process does not include user inputs, this reduces the likelihood of high usage levels. Three of the top four organizations, in usage levels, actively solicited user input before implementation. Lower usage organizations did not engage in this practice. The implementation process is also facilitated by organizational member's knowledge of plans for technological change. When personnel are aware of planned changes, they can prepare themselves for it, and are not surprised by the appearance of something new on their computers. This makes the change less abrupt and eases the transition, reducing resistance generated by suddenness.

Finding #16: Funding levels are less critical than spending patterns

The amount of funding is secondary to the enculturated ways of spending it. It was revealed during the interviews that the Air Force enculturates its people to spend money on tangible products, instead of processes. Related to this, in so far as time equals money, time was reportedly not provided for enticing new users, training, or experimentation. Without the time being expressly provided for these activities, organizational members will concentrate solely on their work tasks, and accomplish them in the same way they have always done them - manually or with minimal automation.

Finding #17: Security can be a facilitator or an inhibitor of IT implementation

Security requirements play an important role in usage of office information and communication technologies. Because classified data must be protected, and often is supposed to be available only to a few organizational members, dealing with secure data produces special information and communication technology requirements. When organizational members have different levels of security clearances and are restricted in their communication with each other about the data they work with, implementation of information and communication technologies is made very problematic. Furthermore, usage will be curtailed by organizational members' reluctance to spill the beans, so to speak. Another problem identified in the automation of secure offices is the necessary, but sometimes overzealous, oversight by security officers. When more than one security officer (either internal to the organization, or external to it - e.g. from the Office of Special Investigations) has the authority to make decisions affecting what systems are implemented and how, implementation becomes extremely problematic. Often there is overlap in areas of responsibility and territorial struggles between security officers may ensue, delaying implementation and reducing its likelihood of success. There may also be so many security measures installed in the system that it makes it difficult to use, or limits its usefulness, again inhibiting acceptance and usage.

Finding #18: Work processes have not changed in connection with implementation

The successful implementations that we observed of office information and communication technologies were not accompanied by changes in work process. It was mentioned that the Air Force funds system changes, not work process changes. Technology was not described, in any interview, as producing a change in the way work was accomplished; nor did we discover any descriptions of work process analysis or change as a precursor of systems acquisition or deployment. When work process change was a requirement for the successful implementation of new systems, the change was perceived as a barrier; the implementation was either not pursued or was not successful.

Finding #19: The contractor environment can either facilitate or inhibit implementation

We found that the contractor environment was in some cases a significant issue for implementation, although this tended to be more a management rather than a user issue. At the user level contractor relationships were described as generally good; comments on contractors as driving implementation or resisting it came from division chiefs and SPO directors. One program manager described a contractor/customer environment that was a clear inhibitor of systems implementation: a dual-sourced avionics device, with a third contractor as systems integrator, more than a dozen aircraft ("customers") that it was required to fly on, a half-dozen other devices that it was required to interface with, and numerous integration, calibration, and data communication problems. In this complex environment, critical issues tended to revert to the lowest common denominator of face-to-face meetings for their resolution.

More generally, USAF and industry experience has shown that enterprise integration applications, whether CALS, EDI, or the concurrent processing of engineering changes using a shared CAD database, work best as point-to-point, bilateral solutions. A multilateral environment, such as that of the avionics program, was highly resistant to integration. This was brought out by our data: the single-program SPOs had the highest level of systems implementation.

6.4 Negative or counterintuitive findings

There were three negative (or counter-intuitive) findings that also bear mention. These are patterns that we expected to find, but were not brought out by the data. The first of them is that the ratio of anti-champions to champions was not found to be correlated with usage levels in the organizations studied. More important is that the computer support personnel are active champions, and that none of the anti-champions had enough authority to prevent systems acquisition altogether.

Additionally, organizational prestige could not be correlated with implementation and usage levels of office information and communication technologies: some extremely low prestige organizations had very high usage levels while some extremely high prestige organizations had very low usage levels. This variable was convoluted because reasons for levels of prestige were based on many different criteria including: age, stage of product development, mission, budget, and security levels. Those criteria were inconsistent with each other for each organization, and usage levels were more dependent on other variables than on these. Although organizational prestige is an important dimension of a sociotechnical system, its effect on the adoption of new information technology is far from linear, reflecting the multi-dimensionality of the phenomenon.

Finally, relationships with the contractors were overwhelmingly described as good. It must be remembered that the reported contractor relationships took place on an individual, personal level, mostly among non-management personnel. It was indicated that it is the high-level management relationships that are strained, if any at all, not the relationships between lower-level, non-management workers. Because external relations were considered good in almost every organization studied, there can be no correlation made between contractor relations on the one hand and implementation and usage of office information and communication technologies on the other.

6.5 Review of guiding hypotheses

These findings in large part support our original guiding hypotheses. We emphasize again that our purpose was not to test these hypotheses, but rather to use them to guide an empirical investigation. Had our results been completely orthogonal with respect to the thirteen guiding hypotheses, then the study would have been misguided. Instead, as summarized in the table below, our findings were consistent with and further developed these guiding hypotheses:

Guiding hypothesis ...	**Result**
#1: Effect of program stage	supported
#2: Volume of paperwork	insufficient data
#3: Stable funding promotes adoption	data inconclusive
#4: Turbulence impedes adoption	all SPOs highly turbulent
#5: Poor supplier relations impede adoption	not an issue at user level
#6: Mission critical activities less interested in OA	insufficient data
#7: Effect of installed advanced IT	supported
#8: Positive user attitudes promote usage	refuted
#9: Basket SPOs less likely to adopt	supported
#10: More recent organizations more likely to adopt	supported
#11: Organizational prestige affects adoption	supported, but not linear relationship
#12: Effect of discipline	appears to have no relationship
#13: Implementation plan	supported

6.6 Success stories and recommendations of the MIS managers

From the success stories collected from CALS vendors and various AFMC components, certain patterns emerge as underlying successful implementation. Among these are:

- Comprehensive planning
- Anticipation of anti-champions and cultivation of champions
- Examination of work processes and routines
- Adequate training and support
- Aggressive implementation strategies work best
- Contractor input is valuable
- User input is essential

After the fieldwork for the FRAME/WORK tool had been completed, the team was given the opportunity to test the findings and the model in an actual implementation situation. The Reconnaisance SPO (ASC/RE) was planning the implementation of several new systems, including video teleconferencing, EDI, and the sharing of CAD files with contractors. With the concurrence of the SPO Director, the team used the interview protocols built into the tool to collect cultural and user attitude data at the SPO. The entire procedure required approximately four hours of interviewing with five SPO personnel. The exact protocol was used in an identical manner to an on-line, computerized assessment.

Subsequent to the assessment, the team provided to the same SPO personnel an alpha version of the recommendations. These recommendations were subsequently packaged into the software tool. This report-out included both an assessment of the leading implementation issues, and recommendations for managing the issues. Discussion with and comments from the IS manager at ASC/RE, indicated that the recommendations were considered to have definite value in planning their implementation of these systems.

Additionally, when we queried the SPO MIS managers in AFMC, we found some common themes that from their experience led to successful implementation. Six patterns came out of the discussion. The patterns, illustrated with direct quotations from MIS directors in the SPOs, are:

> **Communication with and among users is important**. The users do not completely know the requirement for the new system. The communication among the users is important. We have to hold the requirement meeting regularly in order to consolidate all the requirements.
>
> **Old systems must be abandoned**. Get users to give up the old method of doing business. You must give a deadline of when the old software will no longer be available and stick to it.

We had users using Peachtext a year after MS Office was introduced because we failed to take it away from them. With the transition from AMS to a local Email system we are giving clear deadlines and sticking to them.

Leadership must create a positive attitude. There is a natural resistance to change in one's work processes, so you need to convince a user that the new process has value to them, such as taking less time to accomplish their tasking, etc. It goes back to communication prior to implementation. You have to create the positive attitude in the user in order to aid in the success of the system implementation. There is a reluctance of many to share their data with others in the organization because it opens them up to review by others, such as in a program integrated schedule. This is difficult to overcome and sometimes just takes time to allow the process to evolve. Up front communication persuades the users of the benefits of the system, which overrides their reluctance to open their project work to the review of others.

A critical factor in successful implementation of any information technology is positive support from the top of the organization, whether or not he/she is considered the champion.

You MUST have buy-in from the Front Office and Division Chiefs first. You have to show the benefits to be derived by having a standard software suite and be able to identify the pitfalls if not followed. A precedent has been set that can lead credence to others.

The implementation project must have a realistic schedule and realistic capabilities. As with any new initiative, a plan has to be developed to ensure the success of it. Below is a list of those factors deemed critical (necessary) for success. 1. The concept of the project must be SOLD to managers and end-users. 2. Don't make claims to capabilities beyond what is actually possible. 3. Develop a reasonable/realistic, but conservative, schedule. 4. Provide regular updates on the status of the project. 5. If it is required, provide TRAINING!!!!!! 6. Don't work autonomously!!

Creating leadership. One of the critical success factors I have learned is to advertise the new system. Let the knowledgeable people introduce the system to the user and list all the benefits to convince the user. If it is possible, arrange demos to the users as much as possible. When the user starts building the confidence on that system, they will feel more comfortable in using them. Of course the training plays a important role in it.

Support and maintenance are essential. It is essential to the success of the information system that the proper level of support for maintenance and user training be available on-site to respond to needs that are always time sensitive. The system must be on-line or the organization's productivity suffers.

In sum, these lessons and experiences offer clear guidance for any MIS manager planning an implementation of new information systems.

7. USAF Applications

In the course of the FRAME/WORK project, the application of FRAME/WORK and its embedded concepts was pursued for two distinct areas: (1) portable maintenance aids, and (2) DoD directives for systems development and implementation. The results of these two inquiries are presented here:

7.1 Integrated Electronic Technical Manuals (IETMs) and Portable Maintenance Aids (PMAs)

In recent years the Air Force has made significant investments in the development of Portable Maintenance Aids (PMAs). These are rugged, portable, battery-powered computers in which can be stored the Tech Orders and other documentation required for aircraft maintenance. In the traditional, paper-based environment, the aircraft maintainer, usually working out-of-doors on the flight line, had one or several manuals opened beside his job. If a new problem was discovered, he had to make a trip back to the hangar for the necessary manual. If he was working on several interfacing systems, perhaps as many a dozen manuals would be arrayed around him.

Conceptually, with a PMA all of this paper can be replaced with electronic storage and a LCD display. Some of the earliest PMAs, however, were little more than "page turners", containing rasterized images page by page of the technical manuals. This format was more awkward and difficult to use than the paper-based manual, and was not speedily accepted on the flight lines. More recent PMAs have considerably more intelligence built into them: using hot buttons, hypertext, and a relational database, together with augmented storage capacity (up to 1Gb), these more advanced tools potentially represents an improvement over paper. Future integration, through RF links, with the CAMS database should further improve their attractiveness.

In preparation for a presentation on the use of FRAME/WORK as part of a IETM implementation, we studied the cultural issues of the typical flight line. Particularly for enlisted grades, there are a number of cultural and organizational issues that given the right combination of circumstances could interfere with the effective use of PMAs.

The central issue is the means of supervision and control on the flight line. The maintainer is supposed to have his manuals right in front of him, open to the pages he is working on, at all times. Quality Control personnel will check, at least once per shift, to assure this. If the book is not open to the right page, the maintainer will be flagged by QC. Open book reference may not be supported by an IETM, and this sort of visual supervision may be more difficult with an LCD screen.

Related to this is the status order of the typical flight line. At the top is the aircraft itself, as a totemic object; just below the aircraft is its pilot, and below the pilot is the alert crew. Shop personnel are below the alert crew, and supply and depot personnel are below them. The status differences between officers (pilots and managerial personnel) on the one hand and enlisted (supervisors, maintainers, technicians and clerks) on the other may lead to distrust. Maintainers and bench technicians have developed informal ways to adapt to this status difference.

To the extent any integrated maintenance support system infringes on these zones of autonomy (of the crew chief, supervisor, or bench technician, and potentially others in the depot), it may be resisted or manipulated and evaded.

Given this, we found based on our study of this culture that four of the management issues that FRAME/WORK examines have a direct bearing for the flight line. These are:

History of system implementation efforts: previous experience.

Turbulence of the work environment, particularly for higher management levels

Structure of the organization and barriers of distrust

Job design for enlisted personnel on the flight line.

In its current form, the FRAME/WORK tool provides an assessment of these (as well as other) management issues; a streamlined version would provide the same assessment in a far less intrusive manner.

7.2 Integration with Systems Development Procedures

Task 7 of the FRAME/WORK project consisted of the review of applicable Military Standards and procedures for systems implementation, to identify those elements to which the FRAME/WORK architecture and concepts have relevance. In fulfillment of this task, the team reviewed the following documents:

MilStd 2167
MilStd 2168
MilHdbk 8020.1
MilHdbk 8320.1-M, 8320.1-M-1, and 8320.1-M-x

Analysis of 2167 and 2168

These documents set standards for the quality of software and its documentation. The only standard given for implementation of software or systems is on page 2 of 2168, section 4.5, where the contractor is charged with implementing the software in accordance with the SCPP for the duration of the contract. This would permit the specification of the use of FRAME/WORK during the implementation phase of a software development program. There are no human issues or cultural standards identified or addressed in 2167 or 2168.

Analysis of 8020.1

8020.1 gives guidance in process improvement projects required for any information technology implementation. This appears to be the best place to try to include FRAME/WORK as a standard.

The policy in this manual states (pages 2-3) that "important gains in functional and information management effectiveness and efficiency can be achieved by continued evaluation and restructuring of the way DoD missions are accomplished and supported . . . using integrated and standard processes. Sound business practices will be used to achieve these objectives."

A readiness assessment such as that provided by FRAME/WORK is part of sound business practice and can be an integral part of evaluation and restructuring.

Page 3: "[Specific personnel] will evaluate processes,. . . and implement simplified, streamlined, standardized, and cost effective alternatives to current processes across the DoD. Integrated cross-functional approaches shall be sought wherever possible."

FRAME/WORK is a simplified, streamlined, and cost-effective alternative to implementing new programs and systems without taking into account human issues and cultural factors that may have a negative impact on use of the new systems.

Page 5: "To reduce risk, functional process improvements shall be conducted through the rapid implementation of incremental and evolutionary improvements."

FRAME/WORK will help reduce risk and will allow rapid implementation of incremental and evolutionary improvements to be carried out with a minimum of lost time.

Page 7: "[Specific personnel] will establish and execute internal procedures to routinely identify, evaluate, justify, and implement functional process improvements by ensuring the application of sound business practices (and IM principles and policies) . . .

Page 7: Acquire on a fee-for-service basis and manage interdisciplinary functional and technical resources to prepare plans, analyses, studies, and evaluations of current and proposed processes, data, and [Automated Information Systems].

Page 11: "[Specific personnel] shall develop standard methods and tools to support the conduct of functional process improvement, provide training in their use, and provide technical assistance in all aspects of Defense IM program implementation.

These paragraphs offer justification for using FRAME/WORK and assigning specific personnel the responsibility for its administration and implementation.

Page 12: "... Strategic plans shall be used to document and manage execution of process improvement within each functional area ..."

FRAME/WORK can be incorporated as part of any strategic plan that documents and manages the execution of process improvement.

Pages 3-1 and 3-2: FRAME/WORK fits easily into the concept delineated here that defines functional process improvement and discusses the performance of process improvement. Especially noteworthy is the discussion of interdisciplinary teams that conduct process improvement analysis, evaluation, justification, planning, and implementation. Each of these activities would be enhanced by using the data and strategies supplied by FRAME/WORK.

Analysis of 8320.1-M, 8320.1-M-1, and 8320.1-M-x

These manuals deal with (1) data administration procedures, (2) data element standardization, and (3) DoD data model development, approval, and maintenance procedures.

DoD 8320.1-M is the most relevant to the use of FRAME/WORK.

The area where FRAME/WORK would be most useful is in the development of the annual DoD Data Administration Strategic Plan (DASP) that will be used to define, plan, implement, and operate the DoD Data Administration Program (DAP). The mission of the DAP is "to provide for effective, economic acquisition and use of accurate, timely, and shareable data to enhance mission performance

and system interoperability." Annual Planning Guidance is developed by the DoD Data Administrator and distributed to the components and OSD PSAs to assist in the preparation of their strategic plans.

FRAME/WORK could be used to determine human issues and cultural influences that should be taken into account when preparing the strategic plans.

Provision is made to provide education, training, and consultation services to improve understanding, communication, and acceptance of new roles and responsibilities. Provision is also made to acquire resources required to implement the data administration action plans.

These paragraphs justify the acquisition of FRAME/WORK.

8. Commercialization plans

At Wizdom Systems, Inc., the FRAME/WORK initiative represented an important continuation of the company's efforts in understanding the human side of technology. The successes achieved with the tool development have spurred an interest in its further commercial development.

Failures of organizations to successfully reengineer their business processes and implement new technologies, purported to be as high as 75%, have been widely publicized in recent months. These failures are typically attributed to soft factors, such as lack of management commitment, insufficient planning, and organizational resistance to change. This latter category is currently given an enormous amount of attention in industry conferences, publications, and professional societies as a major factor contributing to reengineering failures. It is widely agreed among these sectors that what is needed is a way to anticipate, prepare for, and overcome the social, organizational, and cultural barriers that impact successful implementation of change. The FRAME/WORK tool, extended to include cultural models and pattern recognition sets for specific government, and commercial organizations/industries can provide a means to do exactly this. Wizdom intends to extend and commercially deploy the FRAME/WORK tool initially in the automotive and healthcare industries and secondly in other government and manufacturing sectors.

For each organization/industry specific model it will be necessary to validate the variables and re-calibrate the model to account for the new variable set. Several of the variables in the FRAME/WORK tool are not unique to SPOs and ALCs. Numerous corporations are characterized by fragmentation and turbulence, and resource scarcity is an abiding characteristic of most government and commercial organizations. Although some variables are unique to the Air Force, others can be generalized to multiple environments, and the model adjusted accordingly. Therefore, developing the FRAME/WORK model for government environments requires a validation of the variables in the specific environment, an identification of any potentially new variables, and recalibration of the model to account for the new variable set.

Wizdom is initially pursuing an adaptation of the FRAME/WORK tool to the automotive and healthcare industries in conjunction with two efforts Wizdom is currently supporting. Following modification of the tool to these two specific industry segments, Wizdom will aggressively market and sell the tool to this community of users. The following paragraphs describe the efforts which will provide the initial industry specific domains for FRAME/WORK expansion.

8.1 Automotive Applications

The Manufacturing Assembly Pilot project, now in its second phase, has achieved an adequate level of understanding the relationships, processes and communication characteristics of the automotive seating supply chain. As a result, the study has generated a set of recommendations to be implemented during 1995 at sixteen automotive firms. Each project participant recognizes that change management is going to be as important, or more important than any technology deployment, and each firm has agreed to commit as much resources as required to see this initiative succeed. Wizdom plans to modify/extend the FRAME/WORK variable set for this industry and prototype the new product in each of these sixteen automotive firms. Feedback from prototype deployments will be used to modify/tune the industry variable set, following which the product will be marketed to the automotive industry at large.

8.2 Healthcare applications

The Health Informatics Initiative (HII) is a visionary, systematic approach to using health information applications to tackle many of the nation's healthcare problems. Information technology plays a key role in healthcare by streamlining paperwork and improving access to health information by communities, patients, hospitals, clinics, schools, public health organizations and research institutions. HII is a project jointly funded by industry and the Department of Commerce Advanced Technology Program (ATP) and administrated by the National Institute of Standards and Technology (NIST).

A major objective of HII is to help define and promote health standards to facilitate a seamless integration of applications, tools, and databases. The new integrated toolset based on a common database of objects will allow complex systems modeling to be achieved faster and more accurately. The application of state-of-the-art health information reengineering tools developed in this initiative and implementation of the changes they bring about will necessitate the same need to assess and manage social, organizational and cultural change being experienced in other industries. The FRAME/WORK tool can fill this need.

The first phase of the HII project will provide three specific new products for the Healthcare Industry. The first product is an extended version of the FRAME/WORK tool to evaluate the human factor issues in this industry. FRAME/WORK will be adapted for healthcare specific applications and prototyped as part of this project. As with the automotive version, prototype feedback will serve to modify and fine tune the tool, after which it will be aggressively marketed to the healthcare industry.

Before commercialization of the FRAME/WORK tool for healthcare and automotive, further validation and field trials of the existing tool are desirable. In addition to its commercial work, Wizdom currently supports several DoD CIM initiatives which could benefit from the human factors and cultural assessment features offered by FRAME/WORK. Wizdom will offer on-site assistance for

nominal remuneration to any DoD component or other government agency that wants to use the tool with a target of 20 different user organizations. The feedback from these field trials will be factored into design modifications. Following rollout of the FRAME/WORK tool for automotive and healthcare, Wizdom will select the government or commercial domain(s) for the next product adaptation.

In addition to supplementary field trials, commercialization of the FRAME/WORK tool requires three general design tasks followed by seven domain specific tasks. The three general design tasks are:

- Restructure database
- Reformat knowledge base
- Design for easy plug-in knowledge bases

For each industry specific rollout Wizdom will perform the following tasks.

- Determine domain variables
- Modify variables
- Engineer Knowledge Base
- Recalibrate tool to new variable set
- Prototype tool in new domain
- Incorporate prototype feedback
- Market domain product

Marketing will be accomplished through the same channels used by Wizdom to market its current products. Namely, advertising in industry related publications, attending industry trade shows, direct mailings to select databases, and featuring the new products in Wizdom sales collateral. Additionally, a module will be added to the Wizdom training curriculum providing training in the new tool. This training will be featured at Wizdom's monthly executive seminars, which will be tailored and promoted within the industry where the tool is currently being marketed.

9. Conclusion: Recommendations and Areas for Future Research

The findings of this research have broad implications for the deployment of new information technology within AFMC. These are evident in the findings presented in section 6. Rather than review these, our conclusion and recommendations will focus on the types of research and tool development that our research found necessary.

9.1 Development concept

In the course of our research we discovered that management culture was a unique and independent variable. That is to say, in the process of systems implementation, the attitudes of the manager have a significant effect independent of both the technology and the culture of the organization. This insight led us to create a tool that would advise and orient management, rather than provide directive findings; and further, it underlaid the design of the report-out screen (figure 8): the thermometer on the right-hand side of the screen shows our conclusion having taken the temperature of the organization in terms of overall implementation health. Every manager we briefed on our results inside his SPO was interested in this.

Based on the receptivity we found to issues like this, and again with perfect hindsight, we conclude that:

> *The next generation of readiness assessment tools should be driven by an understanding of management culture.*

The great strength of the FRAME/WORK tool is in the understanding and insight it provides into user cultural issues. Yet unless these are presented and packaged in terms of the managers' work process and concerns, the manager will find them more academically interesting than practically useful. This leads us to our first recommendation:

> **1. A study of management culture, attitudes and work processes should be a leading task in the development of cultural tools.**

The FRAME/WORK tool would gain further strength through pilot testing and calibration with the personnel and functions that have a decisive impact on technology implementation, including:

> Laboratories developing technology

Staff functions supporting the technology
Vendors providing the technology
Prime contractors promoting or resisting the technology
AFMC and Air Staff champions and initiatives
AFMC and Air Staff supporting or conflicting priorities

We previously stated that an early finding of our study was that the bottlenecks to CALS implementation seemed to be not so much in the SPOs and ALCs as at these higher levels. Yet our only visibility into these was through the eyes of the SPOs and to a lesser extent the ALCs. Our second recommendation is therefore:

2. Further study of technology implementation should be made within the context of an overall Air Force technology implementation model.

Although such models exist describing a rational, idealized (*AS-OUGHTA-BE*) process, we lack models that describe the real, *AS-IS* process with all of its ambiguities, conflicting interests, hidden agendas, and performance shortfalls. Yet without a model of the real (rather than idealized) context, further studies of organizational readiness will simply yield idealized (rather than real) findings. FRAME/WORK finessed this by concentrating solely on the system user.

9.2 Development methods

In our original project plan, beta deployment occupied the last three months of a 17-month project schedule. This is approximately proportional to the percentage of project resources devoted to the beta test, as illustrated in the pie chart on page 39. Although engineering development delays and support delays stretched this out, the general picture of engineering development, followed by field test, followed by refinements and final release, was largely adhered to. This foreclosed what could have been an opportunity to incorporate management culture into tool development. Hence our final recommendation:

3. Science-driven projects should devote at least one-third of project resources to phased beta deployment, with one-third to one-half of the development effort between two or three beta tests.

The model proposed here is a management concept to assure that beta test is an integral part of the development discipline. This will still permit systems to incorporate new scientific discoveries, as we have done here; yet it will increase the likelihood that these discoveries will be used, once the system is released.

Appendices

A. References Cited
B. Interview Protocols
C. Software Design
D. Software Documentation
E. SPO Observations and Findings
F. Briefing Slides

Appendix A: References Cited

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Appendix B: Interview Protocols

There are five interview protocols:

I: Director or Deputy Director
II: Division Chief or Branch Manager (or Deputy)
III: Non-Management Personnel
IV: Rapid Assessment Focus Groups
V: Computer Support

Interview Protocol I: Director or Deputy Director

1. Self biography:
   Name
   Function
   Management style
   Computer training (inside and outside AF)

2. Describe the organizational structure of the SPO, and the type of work handled.
   How many personnel are in the SPO?
   Physical location of SPO personnel?
   What are the sizes of the work groups in which interviewing will take place?
   Is it a single program SPO or a basket SPO?
   Are teams or used extensively? How are they used? Are teams matrixed?
   Are organizational divisions or branches composed of one or multiple disciplines?
   If both functional units and matrixed teams are used, which manager has more authority over personnel?

3. What is the approximate level of funding for the SPO on an annual basis? Has this changed over the past three years? If so, how?

4. Does this SPO deal with any classified (or SAR) data?
   If so, what percentage of the work is secure?
   What is the relationship between security and office computer technology use?

5. At what program stage of the product development lifecycle is the SPO currently working in most intensively: concept, engineering, development, production, deployment, recycling?

6. How does this SPO compare with others in obtaining the type of personnel that it needs?

7. Describe the changes that have taken place in the SPO over the past two years.
   Organizational structure; Leadership; Personnel; Location; Technology

8. What has been the SPO's history of office computer technology use?
   What changes are projected for new computer technology in the future?
   What is the process by which new technology is introduced into the SPO?
   What are the roles of champions and anti-champions in this process?
   Do you have a policy with respect to use of office computer technology? Please describe

9. What is the nature of relationships with outside contractors?
   How does this relationship impact technology use?

10. Obtain an organizational chart

****

Interview Protocol II: II: Division Chief or Branch Manager (or Deputy)

1. Self biography:
   Job description/current assignment
   Function/discipline
   Years in current assignment
   Years in AF
   Years on base
   Education/degrees
   Computer training

2. Describe the nature of your group's work assignment.
   How does your group fit within the SPO? (relationship to SPO mission; matrix relations)

3. Does your group deal with any classified (or SAR) data?
   If so, what percentage of the work is secure?

4. Diagram the flow of work to your group, through the group, and out of your group.
   Depict other groups involved in the flow.

5. In what stage of the product development cycle does your group work most intensely?

6. Who are your customers?
   How is information shared with your customers?

7. How many people are in your group?
   Describe the way in which they are organized (teams, subtasks, responsibilities).

Are your people matrixed? Describe the matrix relations.
Are job tasks shared or individualized?
What are the disciplines represented in your group?
What other groups does your group work with on a regular basis?
Are there any perceived differences in status or prestige between the disciplines represented in your group, or between other disciplines? Describe.

8. Describe the nature of communications, and relationships within your group.
(Probe: social relations; gaps in communication flow within group, between groups, between managers and workers)

9. What is the best division/branch to work for in this SPO?
How would you compare your division/branch to that one?
Is there another division/branch that has an easier time recruiting?

10. What is the size of the budget for your group?
Has the budget changed in the last two to three years? If so, how?

11. How many contractors does your group work with?
What other off-base organizations does your group work with?
What kinds of data is exchanged with the above? How is it exchanged?
Describe the nature of the relationships you have with the above.
Probe: social relationship.

12. Where are your people located? (Numbers and locations)
What are the differences in resources between these locations?
Describe the interaction between people located in different places. (Communication)

13. What is the nature of the project-related data your group is responsible for? Where, and how, is this information stored?

14. Describe any changes in organizational structure, physical location, leadership, or personnel experienced by your group over the past two years.

15. What kinds of office computer technology do you use?
What kinds of office computer technology are used by your group?
(Probe: E-mail, shared databases, workflow tools, EDI, imaging, VTC, CAD/CAM)
Describe any changes in the office computer systems used over the past two years.
Describe the group's history with respect to computer usage.
(Probe: evolution of usage, barriers and facilitators)
What are the major issues involved in the use of computers within this group?
(Probe: contractor issues, security issues)

16. What support has been provided to enable people to work with office computer technology?
    Describe the process of implementation of office computer technology. Who is involved?
    Are there champions or anti-champions for office computer technology use in your group?
    Is there a clear understanding of, or consensus on, the need for and goals of office technology change?

****

Interview Protocol III: Non-Management Personnel

1. Self biography:
    Job description/current assignment

    Function/discipline
    Years in current assignment
    Years in AF
    Years on base
    Education/degrees
    Computer training

2. Describe your current job assignment.
    What kinds of office computer technology tools do you use to do your job?
    (Probe: E-mail, shared databases, workflow tools, EDI, imaging, VTC, CAD/CAM)

3. Who do you work with most closely (consult with most closely or most of the time)?
    How often do you interact with these people?
    Where are they located?

4. Who do you consider your group/team?
    What is the size of this group?
    How do people work together in your group/team to accomplish their work?
    Are job tasks shared or individualized?
    Are you matrixed?

5. Describe the nature of communications and relationships within your group.
    (Probe: social relationships, work relationships, communication)

6. Where does your work come from before it reaches your group?
    What are the steps the work goes through within your group?
    What role does the supervisor play in the work flow?
    Where does the work go after it leaves your group?

Diagram the work flow.

7. What other groups does your group work with to accomplish its tasks? (Include contractors)
   What is the nature of the interaction with these groups?
   (Probe: social relationships, work relationships, communication - gaps between workers, workers and managers?)

8. Describe any changes in organizational structure, physical location, leadership, or personnel experienced by your group over the past two years.

9. What office computer tools does your group use to accomplish its work?
   (Probe: E-mail, shared databases, workflow tools, EDI, imaging, VTC, CAD/CAM)
   Who uses the tools/who does not use them? (Probe: attitudes, management receptivity)
   To what extent are they used?
   How regularly are they used?
   How are these used to enable or support the relationships with other groups?
   What are the issues or concerns that have arisen regarding the use of computer tools to support work?

10. What are the advantages and/or disadvantages of existing office computer technologies?

11. Have there been any changes in office computer tools in the last year? Describe.
    How did this change affect the work of the group?
    What issues or concerns have arisen regarding technology change?

12. Are there any plans for bringing in new office computer tools? Describe.
    How will the new technology affect your work?
    What issues or concerns have arisen regarding the planned changes?

13. Describe the process of new technology implementation.
    Who is involved? (Probe: user input, computer support knowledge and abilities)
    What are the steps that have been taken in the past?
    What actions have been taken to prepare for the arrival of new office computer tools?
    Describe the training given.

14. Are there champions and/or anti-champions that help or inhibit the office technology change process? (Probe: how many, who)

****

Interview Protocol IV: Rapid Assessment Focus Groups

1. Self biographies (for each person present):

Job description/current assignment
Function/discipline
Education/degrees
Computer training

2. What is the nature of the work your group performs?
   Where does your work come from, what do you do with it, where does it go?

3. How do you work together within the group?
   (Probe: social and work relationships)
   Are work tasks individualized or shared?
   Are group members formed into teams? If so, how are they structured?
   How do you communicate within the group? Why?

4. What other groups inside the SPO do you communicate with?
   (Probe: social and work relationships)
   How do you communicate?
   (Probe: gaps within group, between groups, between managers and employees)

5. What groups outside the SPO do you communicate with?
   (Probe: contractors)
   How do you communicate with them?
   How is technology used in this relationship?
   What have been the barriers/facilitators to use of technology with these outside groups?
   What is the quality of relationships with contractors?

6. Describe the amount of data your group deals with.
   Where, and how, is this information stored?

7. What computer tools do you use to do your jobs?
   (Probe: E-mail, shared databases, workflow tools, EDI, imaging, VTC, CAD/CAM)
   Who uses these tools? Who does not use them?
   To what extent are they used?
   How regularly are they used?
   How are these used to enable or support the relationships with other groups?
   How have these tools impacted your work process? (Probe: changes in work process)
   What are the issues or concerns that have arisen regarding the use of computer tools to support work?
   Are there any tools that you are missing? Describe. Why are they missing?

8. What are the advantages/disadvantages of the office computer tools you use?

9. What is the history of technology implementation and usage in this group?

What changes in office technology have occurred in the past two years?
Describe the process of new technology implementation.
Who is involved? (Probe: user input, computer support knowledge and abilities)
What are the steps that have been taken in the past?
What actions have been taken to prepare for the arrival of new office computer tools?
Describe the training given.
What are the barriers to technology implementation/use?

10. Are there plans for new office technology implementation?
    How will the new technology affect your work?
    What issues or concerns have arisen regarding the planned changes?

11. Are there champions and/or anti-champions that help or inhibit the office technology change process? (Probe: how many, who)

12. What changes has this group experienced over the past two years in organizational structure, leadership, personnel, or location?

****

Interview Protocol V: Computer Support

1. Self biography:
    Job description/current assignment
    Function/discipline
    Years in current assignment
    Years in AF
    Years on base
    Education/degrees
    Computer training

2. Describe your current job assignment.

3. What groups does your group support? What is the nature of the interaction with these groups? (Probe: social relationships, work relationships, communication - gaps between computer support and workers, computer support and management)

4. Describe any changes in organizational structure, physical location, leadership, or personnel experienced by your group over the past two years.

5. What office computer technologies are used by the people you support?
    (Probe: E-mail, shared databases, workflow tools, EDI, imaging, VTC, CAD/CAM)

6. What are the advantages and/or disadvantages of existing office computer technologies?

7. Have there been any changes in office computer tools in the last year? Describe.
   What issues or concerns have arisen regarding technology change?

8. Are there any plans for bringing in new office computer tools? Describe.
   What issues or concerns have arisen regarding the planned changes?

9. Describe the process of new technology implementation.
   Who is involved? (Probe: user input, computer support knowledge and abilities)
   What are the steps that have been taken in the past?
   What actions are taken to prepare for the arrival of new office computer tools?
   Describe the training given.

10. Are there champions and/or anti-champions that help or inhibit the office technology change process? (Probe: how many, who)

11. What are the attitudes of the people in the groups you support, with respect to office computer technology?

Appendix C: Software Design

This appendix outlines the software development part of the FRAME/WORK project. FRAME/WORK software is a cultural assessment tool researched and developed by Wizdom Systems, Inc. in Naperville, IL under a Phase II SBIR contract # FA1624-93-C-5016. This tool assesses the obstacles in deploying new technologies in the Air Force and recommends some solutions.

C.1 Requirements

The research team, headed by Dr. Allen W. Batteau, came up with the requirements including:

1. be able to run under Microsoft Windows environment,
2. be able to display questions to the users and store the answers, and
3. be able to draw conclusions based on the answers given by the users and to offer recommendations.

The first requirement asks for the development done under the Windows environment. We decided to use a combination of Visual Basic and Clips. The justification is discussed under section C.4.

The second requirement asks the tool to have the ability to retrieve questions, display them to the users, and log in users answers. This process could be done in a number of ways. We chose to use a database. Databases support structured data storage and retrieval and have many options to choose from. Databases are widely used by almost all the organizations to store and retrieve structured data.

The third requirement called for an expert system. An expert system is able to store the human knowledge in its knowledge base, to use it to against some facts, and to draw conclusions. There are some alternatives to this approach, but none of them offers the modularity, maintainability, and ease of use offered by the expert systems.

C.2 Design

Based on the requirements, we decided to divide the main program into several modules as depicted in Figure C1.

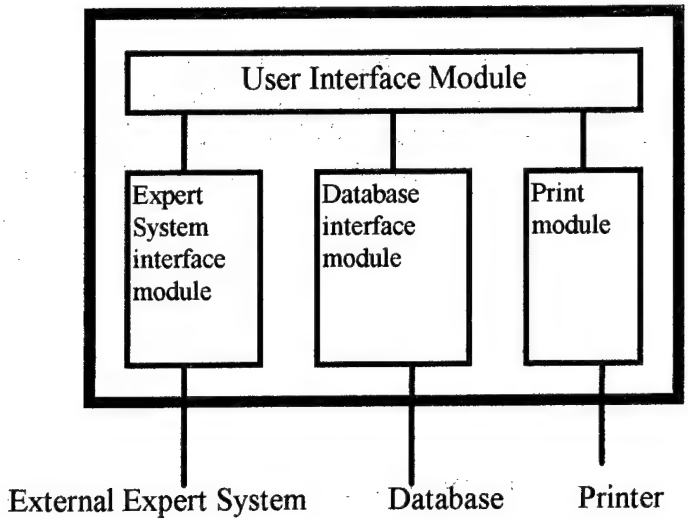

Figure C1 - Software Modules for FWTOOL1.EXE

1. The User Interface Module

The user interface module is responsible to display questions on the screen, handle menu selections, get user choices, and perform user requests. The design of the user interface module follows the standard Windows visual design conventions to minimize the users learn curve. For example, the left most top menu is the file menu and the right most one is the help menu. Since the tool does not have editing capability, the edit on menu was not implemented. Instead, a view menu, which allows the users to navigate through the questions, and an options menu, which allows the users to change the font and color of the display, were implemented. The justification for the view menu design is obvious because we have to allow the users to look at previous questions at any time so they can edit the questions or refresh what they have just answered. The option menu is an added feature for users' convenience.

The questions of the assessments are divided into four groups: commander, subdivision officer, computer specialist, and end user. To distinguish the questions so that a user knows which group of questions he/she is answering, one of the four different frames is drawn on the screen based on which group of questions is displayed. When the tool asks the user which group of questions he/she is going to answer, the same four frames are drawn around four pictures which represent the four different groups. This visual linkage reminds the users which group of questions he/she is answering.

Every effort had been made to ease the guessing game of how to answer a question. If radio buttons are displayed, then the users know only one selection is possible. If check boxes are displayed, however, many choices may be selected. A spinner indicates a numeric answer is expected, and a text box allows the users to type any needed information.

2. The Database Interface Module

The database interface module handles the retrieval questions from and storage of answers to the database. When the user interface module needs to display the next question, it calls the next question function in this module to retrieve it. This function, in turn, gets the question from the database and passes it to the user interface module. When the users answer the question and are ready to move to the next one, the user interface module sends the answer(s) to the record answer function in this module. This function passes the answer(s) to the database. Other functions in this module work in the similar manner.

This design hides the database implementation details from the user interface module. The module provides a number of functions, (e.g. next question), for the user interface to call. The user interface does not know how and where to get the questions. In this way, any changes made in the database module is hidden so the tool is easily maintained.

Using the standard database design principle, the assessment database has six tables:

1. The question table: This table has all the questions.
2. The choice table: This table has all the choices for the questions.
3. The assessment table: This table has general information about each assessment.
4. The responder table: This table records the responders information of the assessments.
5. The assessment responses table: This table records all the answers to the assessments.
6. The text object table: this table has long text which cannot be held by other tables.

3. The Expert System Module

Like the database module, the expert system module handles the interface between the main program (fwtools.exe) and the external expert system. This module offers two functions to the user interface module. When a user wants to see the recommendations, the interface module calls the consult expert function to start the reasoning process. When the reasoning process ends, a number of issues are displayed to the users. If the user selects one of the issues, the selected issue is displayed on the screen by the look up issue function. This design offers the same advantages discussed in the database module.

4. The Print Module

This module was not on the initial design and was added later. The request of being able to print the assessment in a particular format called for the creation of this module because printing should not be the responsibility of the above three modules. This module exports the print assessment function to the user interface module so that when this function is called, the questions and answers from the database are retrieved, formatted, and printed on the default printer.

C.3 Implementation

The implementation of the tool was dictated by several factors:

1. This is a prototype of the would-be commercial assessment tool.
2. The tool had to be produced very fast so that the research team could use it to gather more data in the field.
3. There was limited man power in the development team. The author of this section of the report was the only full time developer. There was another engineer in Wizdom Systems, Inc. who worked only part time initially.

It is obvious we needed a fast development tool to accomplish the design, given the limitations. Visual Basic was selected to implement the user interface module because it offers a fast user interface development and has the built-in database connections. These two features made Visual Basic a better selection than other software programs, (e.g. C++ implementation). Visual Basic is slower than other implementations because it is an interpreted language. Yet the program performance is acceptable partially because users spend the most time reading questions and thinking about answers, and partially because many performance optimization techniques were applied in the code.

Although Visual Basic can handle the requirements for the main program, it has no way to implement the expert system. We wanted an expert system be able to run under Windows and be transparent to the users, preferably a Windows DLL program. Some systems, like GURU, do run under Windows as EXE program with a high price. Some other systems do not run under Windows at all. We finally chose CLIPS (C Language Implementation of Production Systems) developed by NASA Johnson Space Center. Not only does it run under Windows (version 6.0), but also it gives out the source code in C. None of the other expert systems have these two advantages combined. It was also reasonably priced.

1. User Interface Implementation

Given the design, the implementation of the user interface is straightforward. There were, undoubtedly, many technical problems to overcome. One of the problems was the performance. When we implemented question display and clear in a standard way, the performance was poor. The screen was painted too slow and the background frame had to be repainted each time a new question was displayed, which caused flicker on the screen. We tried many solutions and ended up with the solution to repaint the screen with the same question text (but background color) when we wanted to clear the screen. This solution worked very fast and no flickers occurred.

2. Database Interface Implementation

One of the reasons to choose Visual Basic iss that it has built-in database support. In Visual Basic, one can create databases, create tables, insert data, retrieve data, and perform SQLs. For this project, we only need to retrieve data from and store data to the database.

Visual Basic provides three ways to open a database table: as table, as dynaset, or as snapshot. Snapshot is "read-only," so we used it for the question and choice tables. For the other four tables, we could use either the table objects or the dynaset objects to open them. We chose to use the dynaset method because it supports SQL, which we needed in some database operations.

We used dBASE IV for our database implementation simply because our products, like ProcessWorks!, use the same database. We could use other databases as well. Since Client/Server was not a requirement, we simply used local databases.

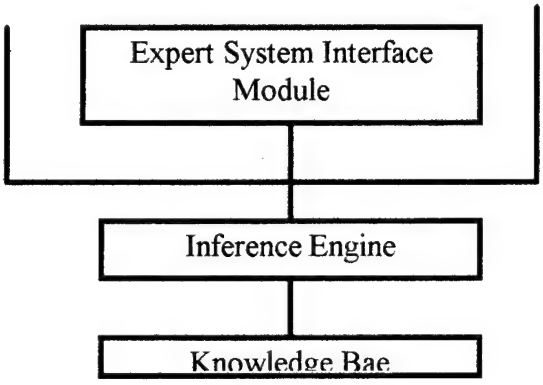

Figure C2 - External Expert System

3. Expert System Interface Implementation

The external expert system has two components as depicted in Figure 2. The inference engine is the brain of the expert system and it does all the reasoning processes. The inference engine uses the rules stored in the knowledge base and the facts (answers) from the main program to draw conclusions. The knowledge base is a text file which stores all the rules supplied by the research team including some initial facts.

We wanted the inference engine to run as a Windows DLL program but CLIPS does not have it. So we took the source code, which was written in C, and converted and compiled it as a Windows DLL. One aspect of this conversion was the size of the DLL. Initially, we compiled the code into DLL with most features turned on. The size of the program was 900K. We thought that was too big. So we turned off many unnecessary features and the size of the released FWEXPERT.DLL was dropped to 200K.

The knowledge base implementation is dictated by the choice of the expert system. Since we chose CLIPS, we must use CLIPS syntax to write our rules. Even so, we still have choices for the reasoning models. Based on the nature of this project, the author of this report proposed, designed, and implemented a Conditional Probability reasoning model in the FRAME/WORK tool. The Conditional Probability model takes care of the uncertainty of the problem by adjusting the probability of each issue, based on each answer to the questions. Please refer to the knowledge base file, FWCOND.CLP, for more details.

C.4 Further development opportunities

The design and implementation of FRAME/WORK were successful. The program satisfied all the requirements and is easily maintained. During the course of design and implementation, the requirements had been changed many times and we were able to accommodate these changes in time because of the initial module design.

The FRAME/WORK tool was designed to be a prototype program so there is a process to convert it to a commercial product. We believe the following steps are necessary to do the conversion:

1. Restructure the database: some fields on some tables may be eliminated because they are no longer needed. Change the database to Microsoft Access to improve performance.

2. Modify the inference engine: current inference engine can only take rules as text files. This process is slow, and proprietary information in the knowledge base cannot be protected. Converting the inference engine to a run-time version solves both problems.

Appendix D: Software Documentation

USAF FRAME/WORK Readiness Assessment Tool

Developed under contract with

Wizdom Systems, Inc.

User Guide

The USAF FRAME/WORK Readiness Assessment Tool is an assessment and expert system for evaluating the human issues in information technology implementation. It is intended to guide management personnel in anticipating user requirements and issues as they implement one of the following types of systems:

e-mail
workflow tools (e.g., Lotus Notes)
engineering and logistics databases (e.g., JEDMICS)
video teleconferencing
CAD/CAM
document imaging (electronic storage & retrieval)
electronic data interchange (X.12-compliant systems)

The tool consists of three parts: an assessment questionnaire, an expert system for analyzing the results from the questionnaire, and a hypertext-based recommendation system. The recommendation system presents the issues that are highlighted by the questionnaire, and a set of recommendations.

FRAME/WORK is a top-down tool. It is intended to assist the leadership of an organization, and is structured so that the command must initiate its use.

These issues and recommendations are based on research conducted in AFMC System Program Offices from October 1992 to October 1994. The research was conducted by a team consisting of personnel from Wizdom Systems, Inc., and Wayne State University.

Additional information on the development of FRAME/WORK can be obtained from Wizdom Systems, Inc.

1. General Concepts

FRAME/WORK is a readiness assessment and management support tool for the task of implementing new systems in a program environment. There are three core concepts that are embodied in the tool:

- **Human issues facilitate or impede technology implementation**. The use of advanced systems, particularly those that change peoples' jobs (such as EDI or workflow tools), is sometimes furthered, and sometimes hindered by issues such as cultural attitudes, organizational barriers, or a command's previous history with implementation. If these issues are not managed, the implementation may fail.

- **The solution to these issues must be managed, not engineered**. If a manager is aware of the issues, he or she will have the resources necessary to address them. However, managing the issues is dependent on numerous, related contextual issues which only the manager can be aware of.

- **A tool is no substitute for management**. A tool such as FRAME/WORK can collect data, analyze data, alert management to issues, focus the issues for the specific context, and provide recommendations. However, acting on the issues requires leadership on the part of the manager.

Within these boundaries, the FRAME/WORK team has developed a tool and a knowledge base that accurately reflects Air Force issues, and places this knowledge in the hands of the manager.

2. Tool Architecture

The FRAME/WORK tool consists of five components, all of which run under a common Microsoft Windows 3.1 graphical user interface. The five components are:

1. **Session and assessment manager**. This is a series of six questions for setting up an assessment and establishing the nature of the session and user. When a new assessment is created, it elicits the command's viewpoint on technology issues, and what type of system is being implemented.

2. **Assessment module**. A series of questions (some for the command, some for managers, some for IT support personnel, and some for users) to assess the implementation environment.

3. **Expert system/inference engine**. A knowledge processor that takes the results of the assessment, and identifies the salient issues in the organization.

4. **Hypertext recommendation module**. As issues are identified, the user sees screens describing them, and can click on different parts of the definition for recommended actions for the issue.

5. **Session log and database**. As assessment information is put into the tool, it is recorded in a database. The tool can store up to five assessments, each codenamed with the name of a famous aircraft. Storage of this information permits the data to be analyzed at any time by any version of the expert system.

These five components form a loosely coupled system, permitting maximum flexibility to both the users and the developers.

3. System Requirements

FRAME/WORK is designed to run under Microsoft Windows 3.1 on a 80386- or 80486-based platform. It requires VGA graphics or higher, and a mouse. It requires a 3.5" floppy drive for installation, and at least 5 mb disk space on the hard drive. We recommend at least a 25mHz processor for best system performance.

One section of the assessment must be completed by at least six system users. The users can either provide their input directly into the tool, or can complete a paper questionnaire. If the latter is desired, the system will generate the paper questionnaire. This paper questionnaire can then be returned for input into the FRAME/WORK tool.

4. Installation

To install the FRAME/WORK tool, simply insert the first installation disk into the floppy drive of your computer. While in Windows, run the file manager. Double click on the A: drive (if A: is the 3.5" drive on your computer). You will see a directory listing for the A: drive.

Scroll down (if necessary) until you see a file named

SETUP.EXE

Double-click on the icon for this file. The setup routine will run automatically.

5. User Guide

Configuration

The configuration cycle consists of a few questions designed to set up the assessment (if you are creating a new one), or establish your role with regard to an existing assessment. The questions are:

Q 1(5): In this assessment, are you

____ Managing the assessment (create new assessment, re-use previous assessment for a new implementation, delete assessment).
____ Providing input to the assessment.
____ Examining the results (review responses, examine issues).
____ Doing none of the above; quit the assessment

If there are no active assessments, only the first and last options will be highlighted.

Q 2(7): Which of the following active assessments do you wish to provide input for or review?

____ Flying Fortress
____ Tomcat
____ Mustang
____ Liberator
____ Sabrejet

Only those that are active will be highlighted. You should act on this question promptly, as the tool will otherwise select the first on the list.

Q 3(10): Do you wish to

____ Create a new assessment
____ Re-use a previous assessment
____ Delete an assessment

This question is available to the assessment manager only.

Q 4(15): Please select a name from the following list for this assessment. This name will be used to identify the assessment for all subsequent input and review:

____ Flying Fortress
____ Tomcat
____ Mustang
____ Liberator
____ Sabrejet

Assessments are given code names from this list.

Q 5(20): Is this tool being used to examine issues at the level of a

____ Program office or directorate (2-letter)
____ Division (3-letter)
____ Branch (4-letter)

Depending on which organizational level is being examined, different questions will be asked.

Q 6(30): What type of information technology are you planning to implement at this time?

____ E-mail (e.g., PROFS)
____ Decision support databases
____ Engineering data databases (e.g., EDMICS)
____ CAD or CAM systems (e.g., Unigraphics, CadKey, Mentor, AutoCad)
____ Electronic Data Interchange (X.12 compliant systems)
____ Document Imaging
____ Video Teleconferencing
____ Workflow tools (e.g., Lotus Notes)
____ Logistics databases

Q 7(32): Please select from this list of active assessments the

one that you wish to use.

____ Flying Fortress
____ Tomcat
____ Mustang
____ Liberator
____ Sabrejet

Q 8(34): Please select from the following list a name that you wish to identify this new assessment by:

____ Flying Fortress
____ Tomcat
____ Mustang
____ Liberator
____ Sabrejet

Q 9(36): Please select from this list of active assessments the one that you wish to delete.

____ Flying Fortress
____ Tomcat
____ Mustang
____ Liberator
____ Sabrejet

Q 10(37): Please click on the box that indicates the type of input you are providing

____ User
____ Organizational Subdivision
____ Computer Specialist
____ Overall Organization

Q 11(38): Are you

____ Providing new input
____ Editing previous input or resuming a previous session
____ Deleting previous input

Q 12(39): Do you wish to

____ Review the input of this assessment
____ Examine and respond to the issues

____ See the recommendations of a previously completed assessment

Q 13(40): Which of the following is the objective of this implementation? (Check all that apply.)

____ Improve productivity
____ Improve communication with remote co-workers (outside of the building)
____ Improve communication with other sites on base
____ Improve communication within work groups (within the building)
____ Streamline workprocesses
____ Improve the quality of our work
____ Other :
____ Don't know

These questions are then used to configure the session.

Assessment

The Assessment Cycle consists of four parts: Command, Manager, System Support, and User. After you have indicated what type of input you are providing, you are given a code number; this is for you to remember, in case you wish to review or revise your input, or provide the input in two or more separate sessions.

The Command Assessment consists of approximately 60 questions. Depending on how certain questions are answered, some questions may be skipped. Completing the Command Assessment requires about 30 minutes.

Most of the questions in the Command Assessment are self-explanatory. A few questions deserve explanation here:

90 What is the office symbol of the group that you are responsible for?

Enter the two-, three-, or four-letter symbol of your directorate, division, or branch.

180 How many organizational subdivisions report to you?

Enter a number.

185 Please highlight the organizational symbol for each of the subdivisions that reports to you.

FRAME/WORK conducts a separate assessment of impacted subdivisions. On this question, you need to highlight one or more organizational symbols. The tool will give you a list of organizational symbols based on the response to the previous question; you highlight these with the mouse, and then add the subdivision letter (e.g., add an "E" to "AV" to make "AVE", and then click ADD)

190 For the information technology you are implementing, will this affect all of these subdivisions? If not, please scroll through the list and indicate which subdivisions will be affected.

Highlight the significant subdivisions. The tool will then generate questions for each of the subdivisions highlighted.

Manager Cycle

The Manager Cycle in the assessment consists of approximately 48 questions. Some of the questions are determined by what sort of technology is being implemented. This section will require approximately 30 minutes for each manager to complete. All of the questions are self-explanatory. However, this section should be completed for each organizational subdivision affected by the implementation. Thus, if in AQ, the subdivisions AQK, AQC, and AQL are affected, but not AQE, this section should be completed for the first three only. The tool will ask in the configuration cycle what subdivision you are completing.

System Support Cycle

Certain questions, having to do mostly with hardware and software, will probably best be completed by your systems support person. There are 28 of these, requiring approximately 20 minutes.

User Cycle

The great power of this tool is in the feedback it provides to the command on user issues. For this reason, it is valuable to have a good representation of users providing input. This input can be provided either on-line, or else by printing a paper copy of the user questionnaire (click on "file", "print", "user questions").

The user section consists of approximately 65 questions, requiring 30 minutes per user to complete. We recommend that at least 6 users provide input; the more users, the more complete your sample.

All of the questions are self-explanatory.

Recommendations

At any time you may examine the recommendations of the tool. You do this by clicking on "recommendations". The tool will then provide you with a list of five issues. Click on one of these, and it will provide a screen describing the issue. Certain parts of the screen will be highlighted in green. By clicking on a green highlight, you will jump to a screen providing a recommendation for that issue. Click on "back" to return to the issue or to the main recommendation menu.

6. Further information and technical support

For further information on the FRAME/WORK tool, contact:

Mr. Philip Clement
Wizdom Systems, Inc.
1300 Iroquois Avenue
Naperville, Illinois 60563
708-357-3000; fax 708-357-3059

Appendix E: SPO Observations and Findings

In the research for the FRAME/WORK project, nine different organizations were examined, and detailed ethnographic data were collected on each. Presented here are two summaries of these data: the levels of implementation of seven different types of systems (e-mail, shared databases, workflow tools, video teleconferencing, document imaging, EDI, and CAD/CAM), and our assessment of the organization on nine critical issues (type of organization, mission, size, fragmentation, turbulence, implementation process, assumptions concerning computing, prestige, and security. These data are presented on the next nine pages.

SPO #1 -- Working in the Vault

Application	Systems used	Comment
e-mail	All-in-One; AMS e-mail; base e-mail;MIS e-mail	not in work area; accessed once a day, not by everyone
shared databases	Threat database; Caretaker II; Federal Acquisitions Regulations; AF Acquisitions Model	Threat database and Caretaker II disconnected when individual user left the org.; FAR outside work area; AFAM used by one person
workflow tools	Automated Management System (AMS); project management software; simulation software; cost modeling software; performance analyzer program; configuration management system	last 3 tool used by single individuals; 2nd and 3rd tools not mentioned during interviewing but mentioned by management in outbriefing
video teleconferencing	None	
document imaging	K5200	not used
EDI	White Knight	use dicontinued when individual user left the organization
CAD/CAM	None	

Systems Profile, SPO #1

Cultural dimension	Key features	Comment
Type of organization	Basket dividsion of basket SPO	
Mission	Acquisition	
Size	c. 60	
Fragmentation	All in same building frequent TDY	2 vaults on different floors of same building; 2 separate sections in one vault
Turbulence	Eliminating branches; creating IPT's; additional documentation required; downsizing=personnel loss; new leadership	
Implementation process	No user input; history of failures; people not informed of plans	Computer support not seen as champs or knowledgeable in usage of systems
Assumptions re computing	Unreceptive culture	
Prestige	Presitigous due to security [v]	
Security	All data=high classification [v]	Important in office automation

Cultural Profile, Organization 1

Component #2 -- Keeping them flying

Application	Systems used	Comment
e-mail	Appletalk	Used only by some engineers, security, and command section
shared databases	Mainframe programs: 1)NSN; 2)part numbers, shipping and receiving, and inventory systems; 3)PC3 personnel system	Used by members of one branch only
workflow tools	None	
video teleconferencing	None	
document imaging	None	
EDI	None	
CAD/CAM	None	

Systems Profile, Component #2

Cultural dimension	Key features	Comment
Type of organization	Basket dividsion of basket SPO	
Mission	Sustainment	
Size	c. 400??	
Fragmentation	All in same building some TDY	One group of offices separated from the rest
Turbulence	Move under new command combining logistics and engineers; additional documentation required; increased regulatory oversight; downsizing=personnel loss; leadership changes	
Implementation process	No user input; history offailures; no plans	Computer support not seen as champs or supporting of entire org
Assumptions re computing	Resistive culture	
Prestige	Presitigous due to security [v]	
Security	All data=high classification [v]	

Cultural Profile, SPO #2

Component #3 -- Planning for support

Application	Systems used	Comment
e-mail	LAN E-mail	
shared databases	LSAR(Logs Sppt Analy Recs); DAMIS(Depot Activ MIS); TIS(Test Info Sheet); STS(Suspense Tracking Sys); TAC(Technical Acquisitions); CLASS (Comprehensive Logs anal Sppt Sys); D-143; 220; GO-57; 72D; 79; 81; DO-32; 34; 35; 39; 41; 43; 62; 63; 87; G005M	Most are databases specific to logistics functions; most used by a number of people in the organization
workflow tools	MIS (Mgmt Info Sys)	
video teleconferencing	Available	Used extensively by mgmt
document imaging	None	
EDI	None	
CAD/CAM	None	

Systems Profile, Component #3

Cultural dimension	Key features	Comment
Type of organization	Single program SPO	
Mission	Sustainment	
Size	c. 130	
Fragmentation	All in same building infrequent TDY	Maintenace crew in another building
Turbulence	Move under new command; creation of IPT's; increase in personnel, but decrease in authorized positions available; leadership changes; policy changes	
Implementation process	No user input; history of failures; most people informed of plans	Computer support not seen as champs; have other duties & not located in same building
Assumptions re computing	Some resistance in culture	
Prestige	Low prestige due to Congress	
Security	Little classified data	

Cultural Profile, Organization 3

SPO #4 -- Global mission

Application	Systems used	Comment
e-mail	All-in-One	
shared databases	ASPIN; AMS; TICARS; PMD; MRP; API; POD; DO43; GO21; GO23; FAR; LSA; GIDEP; FIN (Lockheed); FOXPRO; SERD; SESATS; PMA; ITSD	POD; API; GIDEP; ITSD; and the PMD were used by single individuals; 5 used by people in each branch; 1/3 used by more than one person in each branch
workflow tools	Shared Drives; Cost Calculator; Job Descriptions & Codes; Air Force Forms; Document Tracking Tools	Shared Drives used by a number of organization personnel; rest used only by a few people
video teleconferencing	Available in one of the two buildings	Used often by some, not at all by others
document imaging	Available	Not used
EDI	None	
CAD/CAM	None	

Systems Profile, SPO #4

Cultural dimension	Key features	Comment
Type of organization	Single program SPO	
Mission	Acquisition	
Size	c. 600	
Fragmentation	Divided between 2 buildings; some TDY	Across the street
Turbulence	Creation of IPT's; job description changes	
Implementation process	No user input; history with one failure; most people informed of plans	Computer support seen as champs; large & diverse computer support group.
Assumptions re computing	Some resistance in culture	
Prestige	Moderate due to airframe age	
Security	Little classified data	

Cultural Profile, Organization 4

SPO #5 -- Out in the field

Application	Systems used	Comment
e-mail	Beyond Mail	Changing to Beyond Mail from the VAX All-in-One
shared databases	AWDS; Parts Master; FIN Plan; ALMANAC;	All used by very few people in the organization; 2 used by single individuals
workflow tools	Shared Drives; ACCESS; HERBB (Hanscom Electronic RFP Bulletin Board); AF Forms; CaLANder; ACE-IT (Auto Cost Estimating-Integrated Tools)	Shared Drives used by about fifty percent of organization; others used by less than twenty percent of organization
video teleconferencing	Available	Newly installed; not used
document imaging	None	
EDI	None	
CAD/CAM	None	

Systems Profile, SPO #5

Cultural dimension	Key features	Comment
Type of organization	Basket SPO	
Mission	Acquisition	
Size	c. 350	
Fragmentation	Divided between 2 buildings; some TDY	One building off-base
Turbulence	Creation of IPT's; downsizing; leadership changes	
Implementation process	No user input; history of problems w/ implementation efforts	Computer support not viewed as champs;computer support= 2 contractors; and not knowledgeable in system usage
Assumptions re computing	Some resistance in culture	
Prestige	Moderate	
Security	Little classified data	

Cultural Profile, Organization 5

SPO #6 -- Eyes in the skies

Application	Systems used	Comment
e-mail	All-in-One	
shared databases	LSAR; Grumman's LSA; LCC (Life Cycle Cost) d-base	All three used by one individual only
workflow tools	Shared Drives; ACCESS; ACE-IT (Auto Cost Est. Integr Tools); CONTEXT; HARE (Hanscom Auto RFP); FIN Plan; File Maker Pro; HERBB (Hanscom Elect RFP Bulletin Board); CASE (Comp. Auto Software Eng)	
video teleconferencing	Available	Used frequently by some
document imaging	Available	Seldom used
EDI	None	
CAD/CAM	None	

System Profile, SPO #6

Cultural dimension	Key features	Comment
Type of organization	Single program SPO	
Mission	Acquisition	
Size	c. 550	
Fragmentation	Divided between 2 buildings; remote locations present; frequent TDY	One building off-base; people in other state
Turbulence	Creation of IPT's; leadership changes	
Implementation process	User input solicited; rapid implementation; no history of failures	Computer support seen as champ and knowledgeable in system used; computer support group is large & diverse
Assumptions re computing	receptive culture	
Prestige	Prestigious	
Security	Some classified data	

Cultural Profile, Organization 6

Program #7 -- The orphan program

Application	Systems used	Comment
e-mail	Lotus Notes E-mail	
shared databases	DO43; On Lotus Notes: Open Projects; Closed Projects; Points of Contact; Internal Info; Customer Feedback; Address Book; Trip REports; Leave and Events; Awards; Problem Documentation Sheet	DO43 used by two people; use of Open and Closed Projects was mandatory for all organizational members; five used by a majority; three used by a minority
workflow tools	Shared Drives; ITHINK; WAR (Weekly Activity Rpts); Perform	Shared drives and Perform used by a majority
video teleconferencing	None	
document imaging	None	
EDI	None	
CAD/CAM	None	

Systems Profile, Program #7

Cultural dimension	Key features	Comment
Type of organization	Basket division of basket SPO	Autonomous from SPO
Mission	Sustainment	
Size	c. 45	
Fragmentation	All in one building; frequent TDY	
Turbulence	Creation of IPT's; building location changes; downsizing=personnel loss	
Implementation process	User input solicited; rapid implementation; no history of failures; mandatory usage & training	Computer support seen as champ and knowledgeable in system usage
Assumptions re computing	receptive culture	
Prestige	Low	
Security	No classified data	

Cultural Profile, Organization 7

SPO #8 -- Iron on target

Application	Systems used	Comment
e-mail	All-in One	
shared databases	C-PAS Mapper; SPO-MIS 2; SLIC (Lys Logs Integr Capab)	C-PAS used by 2 people; others used by single individuals
workflow tools	Shared Drives; Project Manage	Shared Drives new, used by a minority; other used by 2 people
video teleconferencing	Available	used infrequently
document imaging	None	
EDI	None	
CAD/CAM	None	

Systems Profile, SPO #8

Cultural dimension	Key features	Comment
Type of organization	Basket SPO	Autonomous divisions
Mission	Acquisitions	
Size	c. 400	
Fragmentation	All in one building; some TDY	
Turbulence	Creation of IPT's; downsizing=personnel loss	
Implementation process	No user input; slow implementation	Computer support viewed as champ; computer support group is large and diverse and new
Assumptions re computing	Resistant culture	
Prestige	Intermediate	
Security	Little classified data	

Cultural Profile, Organization 8

SPO #9 -- Living in a fishbowl

Application	Systems used	Comment
e-mail	Base MIS system	Installing Eudora support (GUI system)
shared databases	TOM (Tech Order Module); DAMIS (Depot Acq. MIS); PMS (Procurement Mgmt System); CDMS (Contract Data Mgmt Sys); FAR (Fed Acq Regs); CLASS (Consolidated Logisitcal Anal Sppt Sys); SLIC (System & Logs Integr Capability);TOCU (Tech Order Control Sys)	CLASS and TOCU are read only databases of the prime contractor; most of these databases used by Logistics and Acquistion branch; PMS and FAR used by contract group; CDMS used by Configuration and Data branch
workflow tools	Shared Drives; Formal Mail	Each division has own shared drive; 2 shared drives are SPO wide· Formail Mail used by majority
video teleconferencing	Available	Used infrequently
document imaging	Avaliable	Used by one division
EDI	None	
CAD/CAM	None	

Systems Profile, SPO #9

Cultural dimension	Key features	Comment
Type of organization	Single Program SPO	
Mission	Acquisitions	
Size	c. 250	
Fragmentation	All in one building; frequent TDY	
Turbulence	New building; increase in personnel; new leaders; program in jeopardy	Big dollar program under Congressional pressure for accountability
Implementation process	User input solicited	Computer support viewed as champ; computer support group is large and divese
Assumptions re computing	Receptive culture	
Prestige	Low	Due to Congressional investigation
Security	Little classified data	

Cultural Profile, Organization 9

In sum, the nine systems and cultural profiles presented here underlie the knowledge embedded in the FRAME/WORK tool. This overview of the data is presented as a guide to further understanding of the relationships between organizational culture and systems implementation.

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